FERC-0066

WATER RESOURCES APPRAISAL
FOR HYDROELECTRIC LICENSING

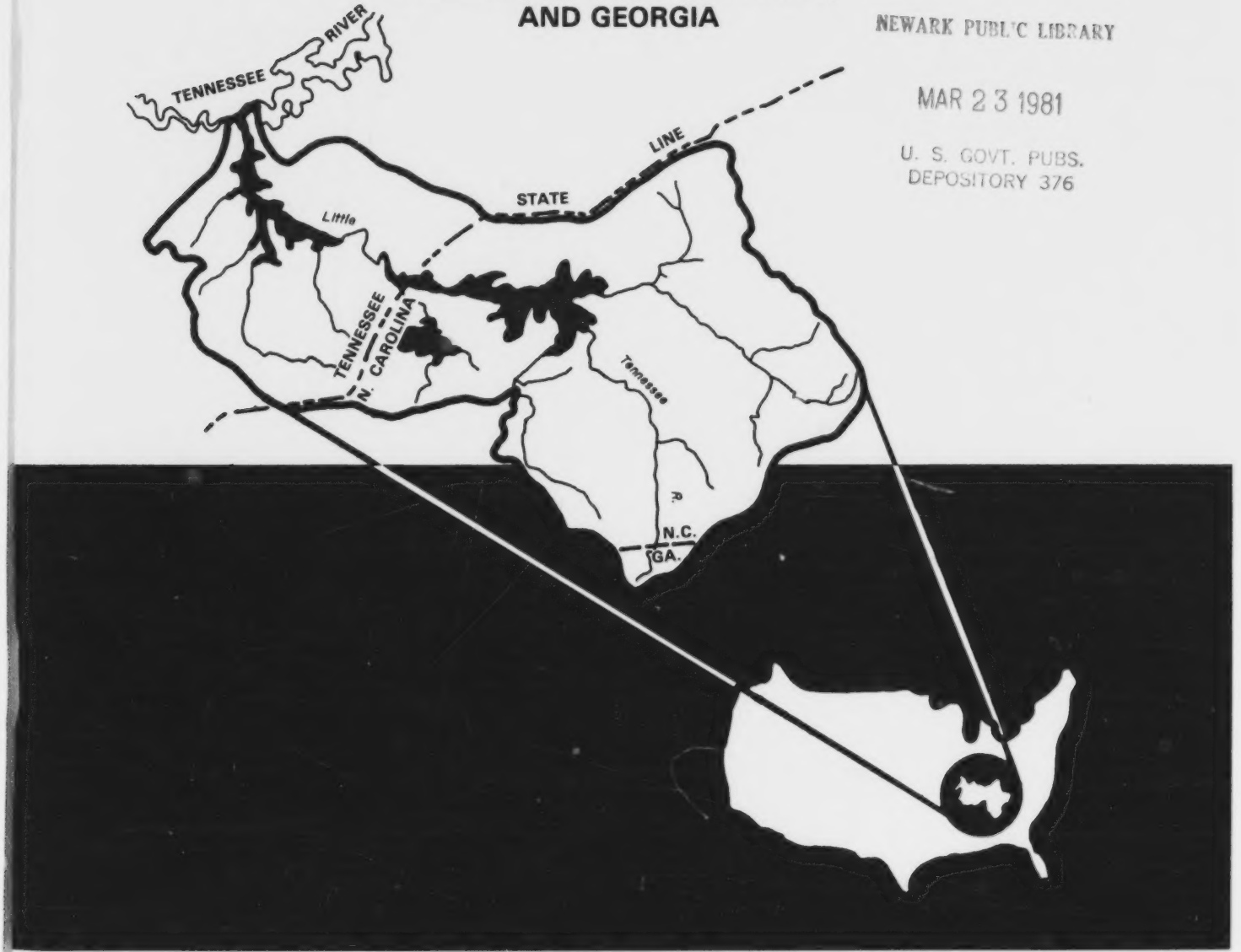
LITTLE TENNESSEE RIVER BASIN

TENNESSEE, NORTH CAROLINA,
AND GEORGIA

NEWARK PUBLIC LIBRARY

MAR 2 3 1981

U. S. GOVT. PUBS.
DEPOSITORY 376



FEDERAL ENERGY REGULATORY COMMISSION

OFFICE OF ELECTRIC POWER REGULATION
JANUARY 1981

E 2.12:

FERC-0086

APPRAISAL REPORT

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING

LITTLE TENNESSEE RIVER BASIN

TENNESSEE, NORTH CAROLINA, AND GEORGIA

FEDERAL ENERGY REGULATORY COMMISSION

OFFICE OF ELECTRIC POWER REGULATION

JANUARY 1981

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON, D.C. 20402

PREFACE

The Federal Power Act, as amended, authorized the Federal Power Commission to undertake investigations of the water resources of any region to be developed; to cooperate with the executive departments and agencies of Federal and State governments in water resources planning; and to issue licenses to non-Federal interests for construction, operation, and maintenance of dams, powerhouses, and appurtenances for hydroelectric power development and other purposes. The Act reserves to the United States the right to take over a non-publicly owned project upon expiration of the license after paying the licensee's net investment in the project, not to exceed fair value of the property taken, plus severance damages, if any. Projects to be licensed or relicensed must, in the judgment of the Commission, be best adapted to a comprehensive plan for improving waterways for the benefit of interstate commerce, for water power development, and for other beneficial public uses, including recreation.

On October 1, 1977, pursuant to the provisions of the Department of Energy Organization Act (DOE Act), Public Law 95-91, 91 Stat. 565 (August 4, 1977) and Executive Order No. 12009, 42 Fed. Reg. 46267 (September 15, 1977), the Federal Power Commission ceased to exist, and its functions and regulatory responsibilities were transferred to the Secretary of Energy and the Federal Energy Regulatory Commission which, as an independent commission within the Department of Energy, was activated on October 1, 1977. On December 23, 1977, the Secretary issued an order amending DOE Delegation Order No. 0204-1 further delegating to the FERC the authority, under section 4(a) of the Federal Power Act (Act), to continue its activities as they relate to river basin appraisals.

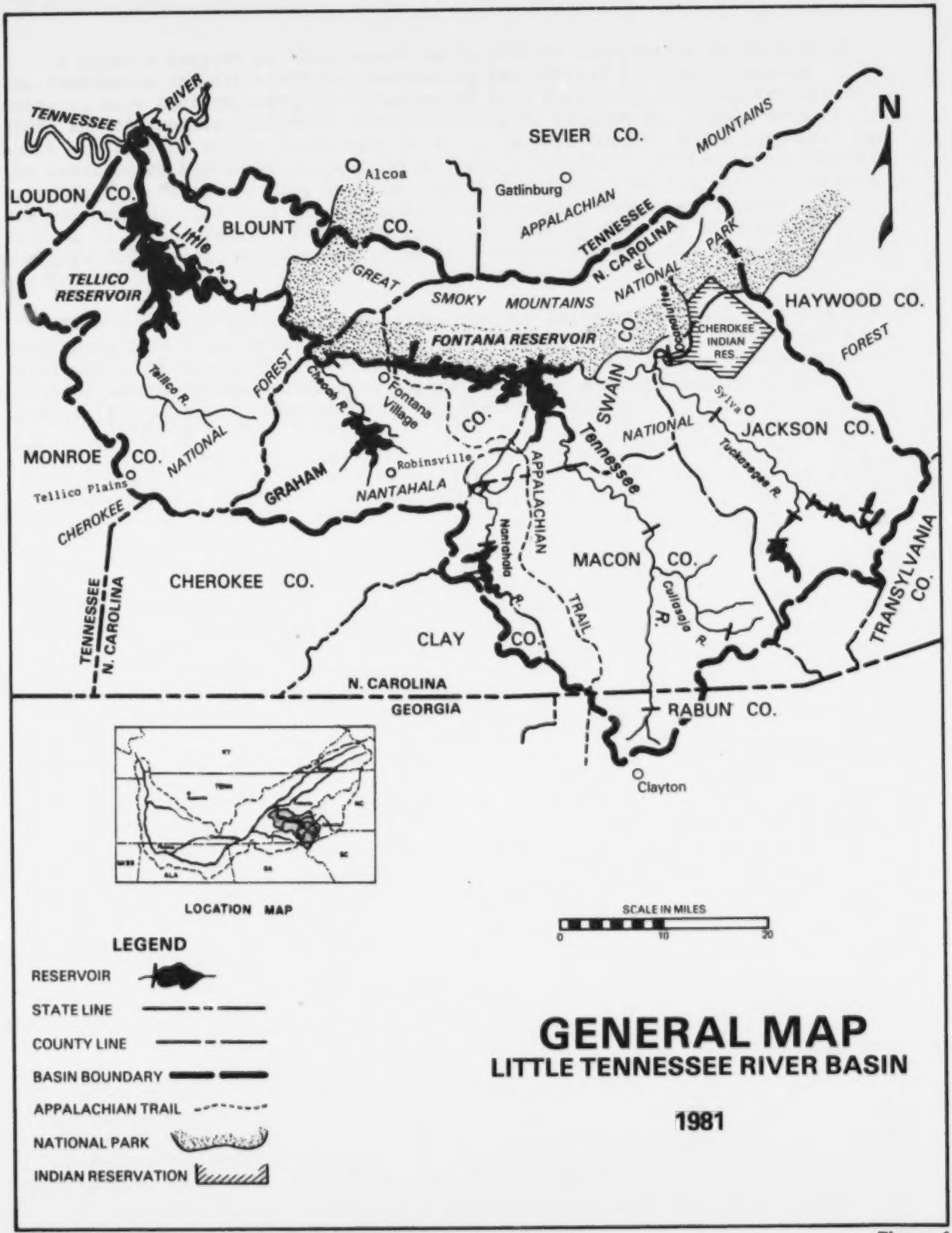
For the purpose of this report, all references to the "Commission" when used in the context of an action taken prior to October 1, 1977, refer to the Federal Power Commission; when used otherwise, the reference is to the Federal Energy Regulatory Commission.

This report on the Little Tennessee River basin has been prepared by the Division of Environmental Impact Studies-Argonne National Laboratory (U.S. Department of Energy) in cooperation with the staff of the Federal Energy Regulatory Commission as part of a program of Water Resources Appraisals for Hydroelectric Licensing. It is intended primarily to provide information which the Commission and its staff may use or build upon, as appropriate, in considering matters related to hydroelectric licensing in the basin.

It has been prepared to highlight, and where possible, to supplement available information in order to enable the staff and the Commission to act expeditiously and judiciously on matters pertaining to the licensing of existing hydroelectric projects and the development of the hydroelectric power potential of the Little Tennessee River basin, together with other desirable water uses and environmental concerns. The report is a staff study which was not prepared for adoption or approval by the Commission, and does not commit or prejudge later Commission action.

A primary purpose of this report is to provide information to be used by the Commission and its staff in considering the several pending licensing matters; more particularly, the constructed East Fork project (FERC Project No. 2698) and the constructed West Fork project (FERC Project No. 2686), both of which are located on the Tuckasegee River in Jackson County, North Carolina; and the constructed Nantahala project (FERC Project No. 2692) located on the Nantahala River in Macon and Clay Counties, North Carolina. The projects at present are unlicensed. The only project under consideration for a new license under section 15 of the Federal Power Act (Act) is owned by the town of Highlands, a municipality; hence, it is exempt from the recapture provisions of section 14 of the Act.

This report is based on reconnaissance-type information, with more precise data being used where available. Although several agencies and individuals have participated in discussions pertaining to the information in the report and have provided useful background data or suggestions, the plans presented do not necessarily carry the endorsement of any agency or group.



GENERAL MAP
LITTLE TENNESSEE RIVER BASIN

1981

FERC - Water Resources Appraisal for Hydroelectric Licensing

Figure 1

SUMMARY

The Little Tennessee River basin is located in the Appalachian Mountains of southeastern Tennessee, southwestern North Carolina, and northern Georgia and has an area of 2,627 square miles. The basin is drained by the Little Tennessee River which originates in the mountains of northern Georgia and flows generally in a northwesterly direction, entering the Tennessee River at mile 602 immediately downstream from Ft. Loudoun Dam. The main tributaries forming the river are the Tuckasegee, Nantahala, and Oconaluftee Rivers in the eastern half of the basin, and the Cheoah and Tellico Rivers in the western half. The average discharge of the Little Tennessee River at its mouth is about 5,800 cubic feet per second.

The topography of the basin ranges from rugged, mountainous country in upstream reaches to gently rolling terrain in the lower river valley. Most of the land in the watershed is forested and lies within the Great Smoky Mountains National Park and the Cherokee and Nantahala National Forests. Most major tributaries originate at elevations between 2,500 and 5,000 feet, while the mouth of the Little Tennessee is at 750 feet. Much of the lower valley is prime farmland. Soils in the mountainous areas are shallow but well drained and, although less fertile than valley soils, are well suited for timber production.

The basin has a distinctly humid climate, with precipitation averaging approximately 59 inches, annually. Precipitation patterns in the basin are largely controlled by orographic factors. Temperatures vary depending on season and altitude and range from -10 degrees to 100 degrees Fahrenheit. The average annual temperature near the project areas is 54 degrees, with a winter average of 37 degrees and a summer average of 70 degrees.

The population density of the basin is low, averaging about 53 persons per square mile, 75 percent of whom are rural. Median family income is 30 percent below the national average. The economy of the basin is based primarily on manufacturing, tourism, agriculture, and forestry. While the basin does not have an extensive transportation network, it is served by railroads, commercial airlines, and highways. The area has abundant scenic attractions and outdoor recreation facilities. Boating, fishing, camping, horseback riding, rafting, kayaking, hunting, and hiking are among the popular recreational pursuits in the basin.

Ample, high-quality ground and surface water supplies exist in the basin. Streams and aquifers are widely used as municipal and industrial water sources, with approximately 80 percent of needs met by surface waters. Water quality throughout the basin is good to excellent. There is no need for irrigation in the basin and, at the time of this appraisal, there was no commercial navigation, although commercial navigation is scheduled to begin on the lower 30 miles of the Little Tennessee River with the filling of the Tellico reservoir in 1980. No steam-electric plants exist in the basin and none are planned.

There are 17 existing hydroelectric developments in the Little Tennessee River basin with a total installed generating capacity of 663.1 megawatts. Another development will come into being with the filling of the Tennessee Valley Authority's Tellico reservoir, which is designed for storage only. The Fontana development is also owned and operated by the Tennessee Valley Authority (TVA). The Fontana multiple-purpose development is operated for hydroelectric power, flood control, and recreation purposes. It is the largest in the basin with a generating capacity of 238.5 megawatts, and has a January flood control storage capacity of 771,200 acre-feet and a summer flood control storage capacity of 21,000 acre-feet. TVA's Tellico reservoir will have a January flood storage capacity of 126,000 acre-feet and a summer storage of 33,000 acre-feet. The Tellico reservoir will have no hydroelectric facilities but will be connected to Fort Loudoun reservoir by means of a canal. By supplementing flows to Fort Loudoun powerplant Tellico can effectively produce up to 200 million kilowatt-hours of electric energy annually. The 16 other existing developments in the basin have generating capacities ranging from 225 to 121,500 kilowatts; none are operated for flood control purposes. Of these 16 privately-owned developments, 4 are owned by Tapoco Inc., 10 by Nantahala Power and Light Company, 1 by the town of Highlands, North Carolina, and 1 by Georgia Power Company. Tapoco's four developments are licensed by the Federal Energy Regulatory Commission (FERC) as Project No. 2169, the town of Highlands' development as Project No. 693, and four of Nantahala Power and Light Company's developments as Project Nos. 2601, 2602, 2603, and 2694. Six projects owned by Nantahala and one small project owned by Georgia Power Company are unlicensed.

The hydroelectric projects which are detailed in this report are the six unlicensed major developments owned by Nantahala: the constructed East Fork Project No. 2698 comprising Cedar Cliff, Bear Creek, and Tennessee Creek developments; and the West Fork Project No. 2686 comprising Thorpe and Tuckasegee developments, both located in the headwaters of the Tuckasegee River in Jackson County, North Carolina ; and the Nantahala project, located on the Nantahala River in Macon and Clay Counties, North Carolina. The six developments are the subject of major license applications presently pending before the Commission. The developments are operated by TVA for power generation and flow regulation under terms of the Fontana Agreements between TVA and Nantahala Power and Light Company.

The East Fork project includes the Cedar Cliff, Bear Creek, and Tennessee Creek hydroelectric developments which were constructed in the early 1950s and have a combined installed capacity of 26,175 kilowatts. The West Fork project includes the Thorpe and Tuckasegee developments which were completed in 1941 and 1950, respectively. The total nameplate capacity of the project is 24,600 kilowatts. The Nantahala project consists of the Nantahala dam and powerhouse plus the Dicks Creek and White Oak Creek diversion dams, which were completed in 1942, 1948, and 1949, respectively. The installed nameplate capacity of the project is 43,200 kilowatts.

Basin development is undertaken by the Tennessee Valley Authority, an agency set up by the TVA Act of May 18, 1933. The Act authorizes construction of water control projects for navigation, flood control, and production of electricity. It also provides for reforestation, marginal land use programs, agricultural and industrial development, certain national defense functions, and other purposes.

The East Fork, West Fork, and Nantahala projects are in good physical condition and appear to be capable of providing an economic source of power for the foreseeable future. Further studies should be made to consider the economic feasibility of increasing their generating capacity. Minimum flow regulations and reservoir water level fluctuations for the benefit of fish is a consideration in the possible licensing of these three projects.

There is an identified potential in the basin to develop 4,600 megawatts of new capacity at several possible future hydroelectric projects, 98 percent of which would be pumped storage.

CONTENTS

	Page
PREFACE	iii
SUMMARY	vii
CHAPTER I - Description of the Basin	1
Location and Drainage Area	1
Physiography and Geology	3
Archaeology	4
Climate	4
Streamflow	4
CHAPTER II - Prior Reports and Current Investigations	7
Prior Reports	7
Current Investigations	8
CHAPTER III - Economy of the Basin	9
General	9
Population	9
Employment and Personal Income	9
Agriculture	10
Forestry Products	12
Mining	13
Transportation	14
Recreation	15
Manufacturing	16
Electric Utility Systems	16
Water Availability and Use	16
CHAPTER IV - Existing Water and Related Land Resources Development*	19
Hydroelectric Power	19
Tellico (TVA)	22
Project No. 2169	25
Chilhowee	25
Calderwood	26
Cheoah	26
Santeetlah	26
Fontana (TVA)	26
Highlands (Project No. 69?,	27
Franklin (Project No. 2603)	27
Queens Creek (Project No. 2694)	28

*Note: Other existing hydroelectric power developments are discussed in Chapters V, VI, and VII.

CONTENTS

	Page
Bryson (Project No. 2601)	28
Dillsboro (Project No. 2602)	29
Estatoah (Unlicensed)	29
Navigation	30
Flood Control	30
Water Supply	31
Water Quality	31
Steam-Electric Facilities	33
Recreation	33
Fish and Wildlife	35
CHAPTER V - The East Fork Project	37
History	37
Description of Physical Works	38
Cedar Cliff	38
Bear Creek	43
Tennessee Creek	43
Condition of the Project	44
Operation	45
Recreational and Environmental Aspects	46
CHAPTER VI - The West Fork Project	49
History	49
Description of Physical Works	50
Thorpe	50
Tuckasegee	50
Condition of the Project	54
Operation	55
Recreational and Environmental Aspects	57
CHAPTER VII - The Nantahala Project	59
History	59
Description of Physical Works	60
Condition of the Project	60
Operation	64
Recreational and Environmental Aspects	66
CHAPTER VIII - Future Development of Water and Related Resources	69
Potential Basin Developments	69
Future Operation of Study Projects	72
Continued Operation of Present Facilities	72
Abandonment	72
Installation of Additional Generating Capacity	76
Environmental Considerations	77
CONCLUSIONS	79

TABLES

Table		Page
1.	Little Tennessee River Tributaries with Drainage Areas Greater than 25 Square Miles	2
2.	Monthly Air Temperatures at Tuckasegee Station, 1961-1972	5
3.	Streamflow Records, Little Tennessee River Basin	6
4.	Population Trends in the Little Tennessee River Basin Economic Area, 1970-1975	10
5.	Number of People Employed in the Little Tennessee River Basin Economic Area in 1970, by Industry	11
6.	Income Patterns in the Little Tennessee River Basin Economic Area	12
7.	Agricultural Data for Little Tennessee River Basin Economic Area, 1974	13
8.	Forestry Data for Little Tennessee River Basin Economic Area, 1974	14
9.	Manufacturing Establishments in the Little Tennessee River Basin Economic Area by Major Industry Group, 1972	17
10.	Existing Hydroelectric Projects, Little Tennessee River Basin	23
11.	Status of Hydroelectric Licensing	24
12.	Summary of Recreational, Fish, and Wildlife Aspects of Existing Hydroelectric Facilities in the Little Tennessee River Basin	34
13.	Pertinent Data, East Fork Project	39
14.	Pertinent Data, West Fork Project	51
15.	Pertinent Data, Nantahala Project	62
16.	Potential Hydroelectric Developments in the Little Tennessee River Basin	70
17.	Economic Analysis for the East Fork Project	73
18.	Economic Analysis for the West Fork Project	74
19.	Economic Analysis for the Nantahala Project	75

FIGURES

Figure		Page
1.	General Map, Little Tennessee River Basin	vi
2.	Principal Electric Facilities in the Little Tennessee River Basin	18
3.	Basin Plan, Little Tennessee River	20
4.	Basin Profiles, Little Tennessee River	21
5.	East Fork Project, General Map	40
6.	Cedar Cliff Reservoir (Photo)	41
7.	Bear Creek Reservoir (Photo)	41
8.	Wolf Creek Reservoir (Photo)	42
9.	East Fork Reservoir (Photo)	42
10.	West Fork Project, General Map	52
11.	Thorpe Reservoir (Photo)	53
12.	Thorpe Powerhouse and Tuckasegee Reservoir (Photo)	53
13.	Thorpe Plant Energy Storage Curve and Operating Guide	56
14.	Nantahala Project, General Map	61
15.	Nantahala Reservoir (Photo)	63
16.	Nantahala Powerhouse (Photo)	63
17.	Nantahala Plant Energy Storage Curve and Operating Guide	65

CHAPTER I

DESCRIPTION OF THE BASIN

Location and Drainage Area

The Little Tennessee River basin, as shown on figure 1, lies primarily in southwestern North Carolina and southeastern Tennessee, with the extreme southeastern tip of the basin extending a short distance into northern Georgia. Greater than two-thirds of the watershed is in North Carolina. The basin includes portions of Swain, Jackson, Cherokee, Macon, Graham, and Clay Counties in North Carolina; portions of Blount, Monroe, and Loudon Counties in Tennessee; and a small part of Rabun County, Georgia. The basin is about 86 miles long from east to west and varies up to about 50 miles in width. The total basin drainage area is approximately 2,627 square miles, essentially all of which lies upstream from Tellico Dam which is located on the Little Tennessee River at mile 0.3.

There are a number of major and minor tributaries in the Little Tennessee River basin upstream from Tellico Dam. A list of those tributaries with drainage areas greater than 25 square miles is given in table 1. The Little Tennessee River flows generally in a northwesterly direction. The principal tributaries forming the river are the Tuckasegee, Nantahala, and Oconaluftee Rivers in the eastern half of the basin and the Cheoah and Tellico Rivers in the western half of the basin. The Little Tennessee, Tuckasegee, and Oconaluftee Rivers originate in the western slopes of the Blue Ridge Mountains; and the Nantahala, Cheoah, and Tellico Rivers originate in the southern Appalachians where these mountains form the southern boundary of the Little Tennessee River basin and the northern boundary of the Hiwassee River basin. The Little Tennessee River enters the Tennessee River immediately below Fort Loudoun Dam at Tennessee river mile 602. The basin comprises approximately 6.5 percent of the total Tennessee River drainage area.

The Little Tennessee River system is one of the most comprehensively developed and regulated river basins in the Tennessee Valley. There are 21 dams on the river and its tributaries that are either directly or indirectly involved in hydroelectric power generation and flood control. The largest development is TVA's Fontana Dam, located at mile 61.0 on the Little Tennessee River. Fontana controls 60 percent of the drainage area of the basin and has 1,157,300 acre-feet of storage capacity, which provides practically complete streamflow regulation to the downstream Cheoah, Calderwood, and Chilhowee generating plants. Tellico Dam at the mouth of the Little Tennessee River can impound 447,300 acre-feet, and the reservoir at full pool extends 33 miles up the river to the base of Chilhowee Dam. Tellico does not contain power generation facilities, but is connected to Fort Loudoun reservoir (on the Tennessee River) by a 1,000-foot canal, and will be operated as an integral part of the Fort Loudoun system for electric power generation, flood control, and navigation. The remaining 16 dams in the basin are all located in the mountainous upstream areas of the basin (see fig. 3) and

Table 1

Tributaries with Drainage Areas
Greater than 25 Square Miles
Little Tennessee River Basin

Stream	Miles Upstream From Mouth of Little Tennessee River	Drainage Area
		(sq mi)
Fork Creek	11.2	47.3
Bat Creek	11.9	31.5
Baker Creek	13.6	43.6
Tellico River	19.2	340.1
Ninemile Creek	20.1	60.1
Citico Creek	31.0	71.9
Abrams Creek	37.0	87.6
Cheoah River	51.2	323.4
Eagle Creek	62.2	30.1
Hazel Creek	64.0	51.3
Tuckasegee River	76.2	670.0
Alarka Creek	82.5	35.0
Nantahala River	85.0	175.0
Burnington Creek	99.7	26.7
Cowee Creek	107.4	25.8
Cullasaja River	117.4	93.0
Cartoogechaye Creek	119.0	58.4

are operated primarily for power generation. Their relatively small storage capacities provide only limited flood control.

Physiography and Geology

Topography within the basin is highly variable. For most of the distance from their sources to where the Little Tennessee River and its tributaries enter Fontana Lake and the other downstream storage reservoirs, the rivers flow through sparsely populated areas of rugged, mountainous country with steep cliffs and many rock outcrops. Most of the rivers originate in the mountains at elevations ranging from 2,500 to as great as 5,000 feet. For the last 30 miles of its course, the free-flowing reaches of the Little Tennessee River change in character from a mountain stream to a placid valley river with a fall of about 3 feet per mile. This section of the river will be inundated in 1980 by filling the Tellico reservoir. The elevation of the Little Tennessee River at its mouth is approximately 750 feet. Most of the land in the watershed upstream of the lower five reservoirs is forested, and much of it lies within either the Great Smoky Mountains National Park or the Cherokee National Forest. The lower reaches of the watershed are characterized by gently rolling terrain, much of which is pasture or under cultivation.

Geologic formations in the higher elevations of the basin are predominantly igneous and metamorphic in origin and are generally paleozoic and precambrian in age. Major rock types in the highlands include granite, biotite, gneiss, schist, and quartzite. Dams for higher elevation hydroprojects are often located on granite and schist dikes. These dense, hard rocks are not soluble and hence have no caves or solution channels. Soils in the mountainous areas of the basin usually have dark brown, loam surfaces and dark yellow loam subsoils. They are located on moderate to steep slopes but are usually well drained. On slopes, hard rocks underlay the soils at depths of 2 to 6 feet, but hilltop soils may range to 20 feet in thickness. Soils on all but the steepest slopes are well suited for timber production. Some of the flatter slopes have been cleared for cultivated crops.

The geology of the lower section of the Little Tennessee River Valley is predominantly sedimentary in nature. Major rock formations are composed of limestones, dolomites, shales, and sandstones. Fractures (joints, cracks, and faults) and solution channels are common in these formations and have long permitted movement of groundwater into and within the rock masses. Rock formations within the valley are overlain with 20-70 feet of alluvial overburden, originating either as recent floodplain deposits or ancient alluvial terrace deposits. Floodplain alluvial soils in the river valley are usually very fertile, and much of the lower valley floodplain is classified as "prime farmland". As previously indicated, with completion of TVA's Tellico Dam project in late 1979 and filling of the reservoir in 1980, approximately 30 miles of the lower floodplain (including nearly 8,500 acres of prime farmland) will be inundated by the Tellico reservoir (dam gates were closed November 29, 1979). Upland areas along the lower valley will not be affected by filling of the reservoir. Most soils in these areas are classified as marginally fertile, and land use is predominantly pasture and hardwood forest.

Archaeology

Numerous cultural resource sites are known in the basin. There are known Indian village sites in the vicinity of the West Fork project on the Tuckasegee River. Judaculla Rock, which bears Indian art work, is near one of the villages. TVA has determined that the area to be flooded for the Tellico Dam project is of considerable archaeological value. TVA has an ongoing archaeological effort in the project area and has recovered over 500,000 artifacts. Humans have occupied the Little Tennessee Valley for about 10,000 years. At least 26 known sites will be inundated by the Tellico project. The area includes Chota, an early capitol of the Cherokee Nation, and several historic structures that are listed in the National Register of Historic Places will be relocated prior to reservoir filling. It is likely that numerous resource sites which may qualify for eligibility in the National Register are scattered all along the river; however, specific site inventories and evaluations would be necessary to make that determination.

Climate

Hydroelectric development in the Little Tennessee River basin has occurred as a result of a combination of topography and high rainfall. The drainage basin receives some of the highest rainfall in the eastern United States, averaging nearly 59 inches annually. In the higher elevation regions upstream of Fontana Dam the average annual rainfall is about 60 inches, and the area below Fontana averages 57 inches per year. Long-term average precipitation at isolated mountain stations located above 3,000 feet elevation ranges from 65 to over 80 inches per year. The greatest 12-month rainfall ever recorded in the Tennessee Valley, 145.5 inches, was measured at a station in the headwaters of the Little Tennessee River near Franklin, North Carolina, between November 1948 and October 1949. Ice and snow storms are common at higher elevations, but significant snow accumulations at lower elevations are comparatively rare. Major storms generally occur when frontal systems move across the area and when hurricanes move inland from the Gulf. Orographic factors are important in determining both amounts and patterns of precipitation in the basin.

Like rainfall, temperatures within the basin vary seasonally and geographically, depending primarily upon altitude. Temperatures in the basin vary from approximately -10 degrees to near 100 degrees Fahrenheit. The Tuckasegee, North Carolina, weather station at an altitude of 2,300 feet is typical of a large proportion of the basin. The average annual temperature at this station is 54 degrees. The winter average (December, January, and February) is 37 degrees. Temperatures at or below freezing are recorded an average of 130 days per year. The average summer temperature (June, July, and August) is 70 degrees. Extremes and average monthly air temperatures for this station are shown in table 2. Air temperatures somewhat lower or higher than those recorded at Tuckasegee occur at various locations in the basin depending on altitude.

Streamflow

Estimates of streamflow for the Little Tennessee River near its mouth are available from records at a gauge near McGhee, Tennessee (located at river mile 19.2) and the USGS gauge below Chilhowee Dam at river mile 32.8 (upstream of the Tellico River confluence). Natural flows at these sites have been affected since 1919 by the operation of several dams on the river. Major flow regulation began in 1944 by closure of Fontana Dam and in 1957 with completion of Chilhowee Dam.

Table 2

Monthly Air Temperatures at
Tuckasegee Station, 1961-1972 (°F)
Little Tennessee River Basin

	Minimum	Maximum	Average
January	29	40	35
February	32	47	37
March	39	55	45
April	52	58	54
May	59	66	62
June	65	71	68
July	68	75	71
August	68	74	70
September	60	72	65
October	51	60	55
November	42	56	45
December	29	45	38
Annual	52	59	54

The 20-year average discharge at the Chilhowee gauge is approximately 5,000 cubic feet per second, which TVA has estimated corresponds to approximately 5,800 cubic feet per second at the Tellico Dam site near the mouth of the river. The difference in discharge values between Chilhowee and the river mouth is due primarily to inflow from the Tellico River, which has an average annual discharge of about 300 cubic feet per second and five other minor tributaries. Maximum discharge recorded at the Chilhowee gauge (installed in 1958) was 41,500 cubic feet per second on May 28, 1973, and the minimum was 20 cubic feet per second on October 4, 1974. The maximum known flood in the lower reaches of the river occurred in March 1867. The peak discharge of this flood was estimated from floodmarks and computed backwater profiles to have been 153,000 cubic feet per second. Streamflows exceeding 100,000 cubic feet per second are believed to have occurred on several other occasions prior to closure of Fontana Dam in 1944. Discharge data at various locations in the basin are shown in table 3.

Table 3
Streamflow Records
Little Tennessee River Basin

River	Gauge Location	River Mile	Drainage Area	Period of Record	Discharge (cfs)		
					Mean	Max.	Min.
			(sq mi)	(yr)			
L. Tenn.	Below Chilhowee Dam	32.8	1987	21	4999	41,500	20
Tellico	At Tellico Plains, TN	28.2	118	54	286	19,900	13
L. Tenn.	At Needmore, NC	92.9	436	36	1074	22,100	52
L. Tenn.	Near Prentiss, NC	119.5	140	36	395	12,200	65
Nantahala	Near Rainbow Spr., NC	34.3	52	39	205	6,300	33
Nantahala	At Nantahala, NC	10.8	144	37	498	7,740	13
Tuckasegee	At Dillsboro, NC	31.1	347	51	795	52,600	35
Oconaluftee	At Birdtown, NC	3.1	184	34	520	15,900	80

CHAPTER II

PRIOR REPORTS AND CURRENT INVESTIGATIONS

Prior Reports

Comparatively few comprehensive reports dealing with the Little Tennessee River basin have been released. The Tennessee Valley Authority (TVA) periodically has submitted reports to Congress covering Tennessee Valley development plans, but these reports have not been widely circulated in the public sector. A Planning Status Report on the Tennessee River basin was published by the FPC in 1966. This report basically outlined current and potential water resource development in the basin. With the exception of the Tellico Dam project, all major development in the basin occurred prior to enactment of the National Environmental Policy Act (NEPA) in 1969; therefore, detailed environmental assessments and reports pursuant to NEPA were not undertaken before 1970.

TVA first considered a dam on the Little Tennessee River at its mouth in a 1936 report to Congress on development of the Tennessee River Valley, and in the early 1940s planned the "Fort Loudoun Extension" (later known as the Tellico project) as part of the Fort Loudoun development on the Tennessee River. However, in 1942, the War Production Board advised TVA that material shortages and priorities did not allow construction of the project at that time, and it was subsequently shelved; but the Fort Loudoun Dam generators were sized to accommodate the additional flow anticipated from future completion of the Fort Loudoun extension. The Fort Loudoun extension was proposed as the Tellico project in 1963.

Draft versions of environmental impact statements (EISs) were prepared by the Commission's Atlanta Regional Office for the constructed East Fork, West Fork, and Nantahala projects in connection with a prelicensing environmental assessment but were not circulated for comment. Final EISs were not prepared. The TVA released a three-volume EIS in February 1972 covering the Tellico project, and in December 1978, following prolonged intervention by groups and individuals opposed to the project, TVA issued a supplemental publication titled, Alternatives for Completing the Tellico Project. Another report, covering the entire Little Tennessee River basin, was recently published by the U.S. Army Corps of Engineers. Prepared as part of its National Hydroelectric Power Resources Study, the Corps published a series of documents entitled Preliminary Inventory of Hydropower Resources in 1979. Volume 5 of the series covers the southeastern region and identifies existing and potential hydropower developments and sites in the Little Tennessee River basin.

The Water Resources Planning Act of 1965 (P.L. 89-80) authorizes the Water Resources Council to maintain a continuing study of the Nation's water and related land resources and to prepare periodic assessments to determine the adequacy of these resources to meet present and future water requirements. The

Council reported its first national assessment in 1968, which put into nationwide perspective estimates of present and future regional water and related land requirements and supplies. The Second National Water Assessment, published by the Council in December 1978, presents nationally consistent current and projected water use and supply information by regions and subregions for the United States. The second assessment found that significant achievements have been made in the past decade in preserving water and harnessing its power with a growing interest in water conservation and environmental protection; and that greater efforts are needed to insure careful management of our water resources and to solve the complex water and related land problems which still exist. A supplemental report to the second assessment, Water for Energy, provides information on energy and related water requirements at the region and subregion level for the years 1975, 1985, and 2000, including cooling water requirements for steam-electric generation.

Current Investigations

The U.S. Army Corps of Engineers' National Hydroelectric Power Resources Study is continuing with emphasis on potential hydropower development (including environmental and economic analysis of potential projects). Three potential sites in the Little Tennessee River basin will be evaluated by the Corps' study. Another ongoing investigation involves comprehensive environmental monitoring of the lower portion of the Little Tennessee River basin by TVA to evaluate the effects of completing the Tellico project and filling the reservoir.

CHAPTER III

ECONOMY OF THE BASIN

General

The Little Tennessee River basin lies in southeastern Tennessee (Blount, Loudon, and Monroe Counties), northeastern Georgia (Rabun County), and the western part of North Carolina (Graham, Jackson, Macon, Swain, and very small areas of Cherokee and Clay Counties). Data for the eight counties located largely in the basin were aggregated to represent the economic conditions within the basin.

Population

In 1975, the population of the eight-county basin area was 190,099--an average of 53 persons per square mile. As shown in table 4, this represented an increase of 10.8 percent in population from 1970. During the same period the United States increased in population by 4.8 percent. Between 1970 and 1975 net migration into the basin was 6.1 percent, while migration into the United States as a whole was 1.2 percent. In 1970, about 12.0 percent of the basin's population was 65 years old or older; the comparable percentage for the United States was 10.5. As illustrated in table 4, 75 percent of the population reside in rural areas, whereas 74 percent of the population of the United States reside in urban areas. The counties in North Carolina and Georgia are nearly 100 percent rural. According to the U.S. Census Bureau, none of the counties are in Standard Metropolitan Statistical Areas.

Employment and Personal Income

In 1975, total income in the economic area was about $80 million. In 1972, manufacturing, the leading employment industry with 25 establishments, paid $6.2 million in wages. Value added was $16.9 million. The 17 wholesale establishments had $13.3 million in sales, the 225 retail establishments $38.9 million, and the 152 service establishments $5.2 million. In 1973, the value of mineral production was $7.2 million. The value of farm products sold in 1974 was more than $3.6 million.

The number of people employed in the basin in 1970 is shown by industry in table 5. Manufacturing, with 36.6 percent of the total, is the most important, followed by service (23.0%), wholesale and retail trade (15.3%), and construction (9.5%).

The 1970 unemployment rate in the basin was 5.2 percent, which was higher than Georgia (3.2%), Tennessee (4.4%), North Carolina (3.4%), and the United States (4.4%). Clearly unemployment was higher in the basin than in the surrounding area.

As indicated in table 6, family income in each county in the basin except Blount was lower than its State median, and the basin economic area median family income in 1969 was $6,162, or 64 percent of the U.S. median family income of $9,586. This same pattern is reflected in more recent data, as the 1974 per capita incomes shown in table 6 indicate.

Table 4

Population Trends
Little Tennessee River Basin Economic Area, 1970-1975

State/County	1970 Population (1,000) Urban[a]	Rural	Total	1975 Population	% Change, 1970-75
Georgia	2,768 (60.0)	1,822	4,590	4,931	7.4
Rabun	0	8.3	8.3	9.3	11.8
North Carolina	2,285 (45.0)	2,797	5,082	5,441	7.2
Graham	0	6.6	6.6	6.6	-1.0
Jackson	0	21.6	21.6	24.2	13.3
Macon	0	15.8	15.8	18.2	15.4
Swain	0	7.9	7.9	10.2	9.1
Tennessee	2,305 (58.7)	1,618	3,924	4,174	6.7
Blount	26.9 (42.2)	36.9	63.7	69.8	9.2
Loudon	9.1 (37.3)	15.2	24.3	26.4	8.6
Monroe	7.0 (29.6)	16.5	23.5	25.4	8.1
Basin Economic Area	42.9 (25.0)	128.7	171.6	190.1	10.8
United States	149,406 (73.5)	53,867	203,273	213,030	4.8

a Numbers in parenthesis represent percent of total.

Agriculture

The pattern of farming in the basin from 1969 to 1974 was similar to that of the Nation. The average size of farms and capital resources increased, and the number of people living on farms decreased.

Economy of the Basin

In 1974, about 18 percent of the land in the eight-county economic area was in farms (4,237 farms). The average farm size was 89 acres, about half the size of the average farm for Georgia, North Carolina, and Tennessee and one-fifth the size of the average U.S. farm. The total market value of all agricultural products sold in 1974 was about $32 million, with an average per farm of $7,047. The average value of land and buildings for all farms in the basin in 1974 was $59,479, which was less than the average values for farms in the three basin States and one-third the value of the average U.S. farm. The average per-farm sales in the basin for 1974 was $7,047, which was five times lower than the national average. Detailed agricultural data are presented in table 7.

Table 5

Number of People Employed
Little Tennessee Basin Economic Area in 1970, by Industry

Industry	Number Employed	Percent of Total
Manufacturing	22,608	36.6
Service	14,202	23.0
Wholesale and retail trade	9,466	15.3
Construction	5,851	9.5
Transportation, communications public utilities	3,036	4.9
Agriculture, forestry & fishery	2,624	4.2
Public administration	2,261	3.7
Mining	313	0.5
Total	61,757	100.0

Twenty-six percent of the basin's farms produced $2,500 or more in income in 1974. Of these farms, the ranking of farm products from highest income to lowest in thousands of dollars was as follows:

Livestock and products (dairy, 11,337; cattle, 5,325; poultry, 4,144; hog and pig, 652; sheep and wool, 4)	21,688
Grain	2,171
Tobacco	2,033
Hay, forage, silage	1,192
Vegetables, sweet corn, melons	534
Fruits, nuts, beans	151
Other field crops	141

Forestry Products

Although a substantial portion of the Great Smoky Mountains National Park lies within the basin, nearly 200,000 acres of its forest have never been commercially logged. Much of Macon and Graham Counties and 9 percent of Jackson County lie within the Nantahala National Forest. In 1964, 84 percent of Jackson County was in forest. Half of the southern portion of the Cherokee National Forest is in Monroe County, Tennessee. Farm woodlands are the largest source of timber in North Carolina, and it is the value of farm forest products which is reflected in table 8. Pulpwood is the most valuable forest product of the basin. The total value of all forest products sold from the basin in 1974 was in excess of $55,000.

Table 6

Income Patterns
Little Tennessee River Basin Economic Area

State/County	1969 Median Family Income				1974 Per Capita Income
	Amount	Percent of State Median	Percent of Basin Median	Percent of U.S. Median	
	(dollars)				(dollars)
Georgia	8165	-	133	85	4091
Rabun	6056	74	98	63	3119
North Carolina	7770	-	126	81	3875
Graham	5750	74	93	60	2880
Jackson	5933	76	96	62	2894
Macon	5654	73	92	59	2922
Swain	5186	67	84	54	2747
Tennessee	7446	-	121	78	3821
Blount	7898	106	128	82	4034
Loudon	6900	93	112	72	3518
Monroe	5921	80	96	62	2730
Basin Economic Area[a]	6162	-	-	64	3106
United States	9586	-	-	-	4572

[a]*Average is unweighted by population.*

Table 7

Agricultural Data
Little Tennessee River Basin Economic Area, 1974

	Number of Farms	Land in Farms	Average Size	Average Value of Land and Buildings	Market Value of All Agricultural Products Sold	
					Total	Average Per Farm
		(acres)	(acres)	(dollars)	(1000 dollars)	(dollars)
Georgia	54,911	13,878,294	253	119,766	1,859,780	33,869
Rabun	163	14,584	89	66,399	2,735	16,781
North Carolina	91,280	11,243,933	123	72,672	2,121,226	23,239
Graham	243	15,790	65	36,574	670	2,757
Jackson	324	21,341	66	45,767	770	2,377
Macon	420	34,559	82	63,513	2,497	5,945
Swain	111	9,810	88	49,862	326	2,941
Tennessee	93,659	13,103,224	140	65,308	933,168	9,963
Blount	1,162	113,750	98	71,695	7,729	6,652
Loudon	791	92,123	116	77,258	6,555	8,287
Monroe	1,023	112,626	110	64,761	10,882	10,638
Basin Economic Area	4,237	414,583	89	59,479	32,164	7,047
United States	2,314,013	1,017,030,357	440	147,838	81,531,026	35,234

About 55 percent of the commercial forest in the basin was hardwoods. In the Tennessee portion of the basin, in 1971, the growing stock volume of commercial forest land was 507 million cubic feet, 235 of which was softwood (mainly, southern pine) and 272 hardwood (mainly, oak and gum). The sawtimber volume on commercial forest land was 1,412 million board feet, 639 of which was softwood and 773 hardwood. The volume of timber in all of North Carolina in 1974 on commercial forest land was also 55 percent hardwoods. There were 15 sawmills and 1 pulpmill in the North Carolina portion of the basin in 1974, and 6 in Rabun County (the Georgia portion of the basin) in 1971. There were 27 small sawmills and 4 other types of primary wood processing plants in 1970 in the Tennessee portion of the basin.

Mining

There were 21 mineral industry establishments in the basin economic area in 1972. Of these, 20 were nonmetallic minerals mining and 1 (in Macon County) was bituminous coal mining. None were involved in oil and gas production, nor anthracite coal. Most counties mined, in order of importance, stone, sand, and gravel, with Loudon County also mining barite. Graham County had no mining operations. Stone is by far the most important mineral mined. The 1973 production value of all minerals mined in the basin was $7,289,000.

Table 8

Forestry Data
Little Tennessee River Basin Economic Area, 1974

Area	Woodland	No. of Woodland Farms	Value of Forest Products Sold in Dollars: Standing Timber or Trees	Firewood	Salvage and Veneer	Pulpwood	Other Forest Products	Total
	(acres)							
Georgia	4,600,930	23,929	18,189,000	51,000	5,111,000	8,424,000	1,324,000	33,099,000
Rabun	3,109	29	L[a]		L	L	L	L
North Carolina	3,310,067	37,862	12,580,000	84,000	1,903,000	1,028,000	293,000	158,880,000
Graham	2,477	54	L	L	L	L	L	L
Jackson	1,593	39	L	L	L	L	5,000	>5,000
Macon	6,601	85	L	L	L	1,000	1,000	>2,000
Swain	1,790	19	L	L	L	L	L	L
Tennessee	2,358,440	31,157	4,357,000	84,000	1,210,000	343,000	134,000	6,128,000
Blount	11,805	283	5,000	1,000	L	10,000	L	>16,000
Loudon	14,026	261	4,000	L	3,000	8,000	L	>15,000
Monroe	15,800	295	5,000	L	0	5,000	7,000	>17,000
Basin Economic Area	57,201	1,065	>14,000	>1,000	>3,000	>24,000	>13,000	>55,000

[a] *Indicates sales of less than $1000 or fewer than three farms with sales.*

Transportation

The Little Tennessee River basin does not have an extensive transportation network. Only 57 percent of the 1,720 miles of road in the North Carolina portion of the basin are paved. A portion of U.S. 129 leading to Knoxville lies within the basin. In North Carolina, the Little Tennessee River flows alongside State Highway 28 and in Tennessee along State Highway 72. In the North Carolina portion of the basin, U.S. 19 crosses from southwest to northeast; U.S. 441 crosses from north to south, and U.S. 129 crosses from northwest to southeast. In the Tennessee portion of the basin, U.S. 411 crosses from southwest to northeast.

All railroads in the basin are freight lines. The Louisville and Nashville passes from southwest to northeast through Monroe, Loudon, and Blount Counties in Tennessee. Just north of it the Southern Railway track lies in the same direction, passing through Monroe and Loudon Counties. There is no railroad in Rabun County. The Southern Railroad passes through Macon, Swain, and Jackson Counties southwest to northeast in North Carolina.

There are several small airports throughout the basin, but the nearest large commercial airport, in Knoxville, is located just outside the basin in Blount County. In 1972, the Knoxville airport had 16,563 airplane departures and 363,405 passenger enplanements.

Economy of the Basin

The East Tennessee Natural Gas Company pipeline lies southwest to northeast between Chattanooga and Knoxville, running through Monroe, Loudon, and Blount Counties and across the Little Tennessee River. There are no other gas pipelines, existing or under construction, in the basin.

There are no crude oil nor liquid gas pipelines in the basin. There are two petroleum product pipelines in the Tennessee portion of the basin between Chattanooga and Knoxville. One is 10 inches or larger, and the other is smaller than 10 inches.

Recreation

The Little Tennessee River does not have the shoals, large rocks, rapids, and white water that make a river an unusual scenic attraction although the Nantahala and other rivers do. The Little Tennessee is used for canoe and rubber raft floating, but less than 5 percent of the river use (1,500 visits to the river) was for this purpose in 1974.

The Great Smoky Mountains National Park, which lies partially within the basin, is the most heavily visited unit in the national park system, with 8,695,500 visits in 1978. The Appalachian Trail lies within the Park along the northern perimeter of the basin and turns southward through the basin along the Tennessee-North Carolina State line.

Lakes and reservoirs are used intensively for boating and fishing, but road access to many of the upstream Little Tennessee River lakes is poor. To expand such recreation areas would require building roads in the park or in the Nantahala National Forest. The western portion of the basin has lakes which are being fished at about 15 percent of capacity. Many of the lakes and reservoirs in the basin are available for fishing, boating, boat launching, waterskiing, picnicking, camping, and swimming. In North Carolina many reservoirs in the basin and tributaries of the Little Tennessee River are stocked with trout. The inland water area of the basin is 180 square miles (115,200 acres), or about 5 percent of the basin area. Thirty-eight percent of the North Carolina portion of the basin is considered recreational acreage, meaning 6.73 acres of recreational acreage per capita.

The North Carolina portion of the basin is almost entirely the multi-county planning Region A of the State of North Carolina. The vegetative cover is primarily woodland and pasture (93%) with small areas of cropland (see "Agriculture", this chapter). The area topography comprises rugged mountains and beautiful scenery with outstanding vistas. The predominant land use is woodland (88%); cropland use is 3.7 percent. The Federal Government is the major landowner with over 800,000 acres. There are 1,573 miles of trout streams, and the North Carolina Wildlife Resources Commission manages four game areas totaling 398,540 acres. The Federal Government operates the Blue Ridge Parkway, Great Smoky Mountains National Park, Nantahala National Forest, Cherokee National Forest, and the Joyce Kilmer Memorial Forest and Wilderness. All are actively used for recreation. For example, activities in the Great Smoky Mountains National Park include hiking, horseback riding, backcountry camping, bicycling, fishing, canoeing, tubing, picnicking, and camping.

Manufacturing

Manufacturing is the most important single industry in the basin (see "Employment and Personal Income", this chapter). In 1972, there were 199 manufacturing establishments in the basin, 70 of which employed 20 or more persons. These 199 establishments employed more than 7,800 people on a yearly payroll of more than $42.3 million. Their value added in manufacturing for 1972 was more than $92 million, and new capital expenditures were more than $4 million.

The region's top manufacturing industries as judged by the number of establishments (see table 9) are furniture and fixtures (34.2%), tobacco (10.1%) and primary metals (9.6%). The emphasis on primary metals ties in with the fact that Aluminum Company of America (ALCOA) owns most of the hydroelectric facilities in the basin and the electricity from those plants goes primarily to the primary metals industry (see "Electric Utility System" below). Furniture and fixtures tie in to the local supply of wood. Monetarily, tobacco is the third most important agricultural product of the basin (see "Agriculture").

Electric Utility System

There are three principal and two minor electric utility systems operating in the Little Tennessee River basin, with a total installed capacity of 663.1 megawatts. The principal electric facilities in the Little Tennessee River basin vicinity are shown in figure 2. Ownership, licensing status, and plant descriptions are presented in tables 10, 11, 13, 14, and 15. All plants in the basin are hydroelectric and are discussed in more detail in chapters IV, V, VI, and VII.

The two major private utilities in the basin, Tapoco Inc. and Nantahala Power and Light Company, are subsidiaries of ALCOA and most of the electric energy derived from their dams is used for electrometallurgical purposes. The major developments are operated, however, by TVA for hydroelectric purposes and flow regulation under an agreement between ALCOA and TVA known as the New Fontana Agreement. TVA in turn makes power available to Tapoco and Nantahala from TVA's system in accordance with this Agreement.

All companies are members of the Southeastern Electric Reliability Council, a voluntary council open to all bulk power suppliers in the 10 southeastern States. The purpose of this council is to promote reliable operation in interconnected bulk power systems in the southeastern region. It is one of nine electric reliability councils in the 48 contiguous States.

Water Availability and Use

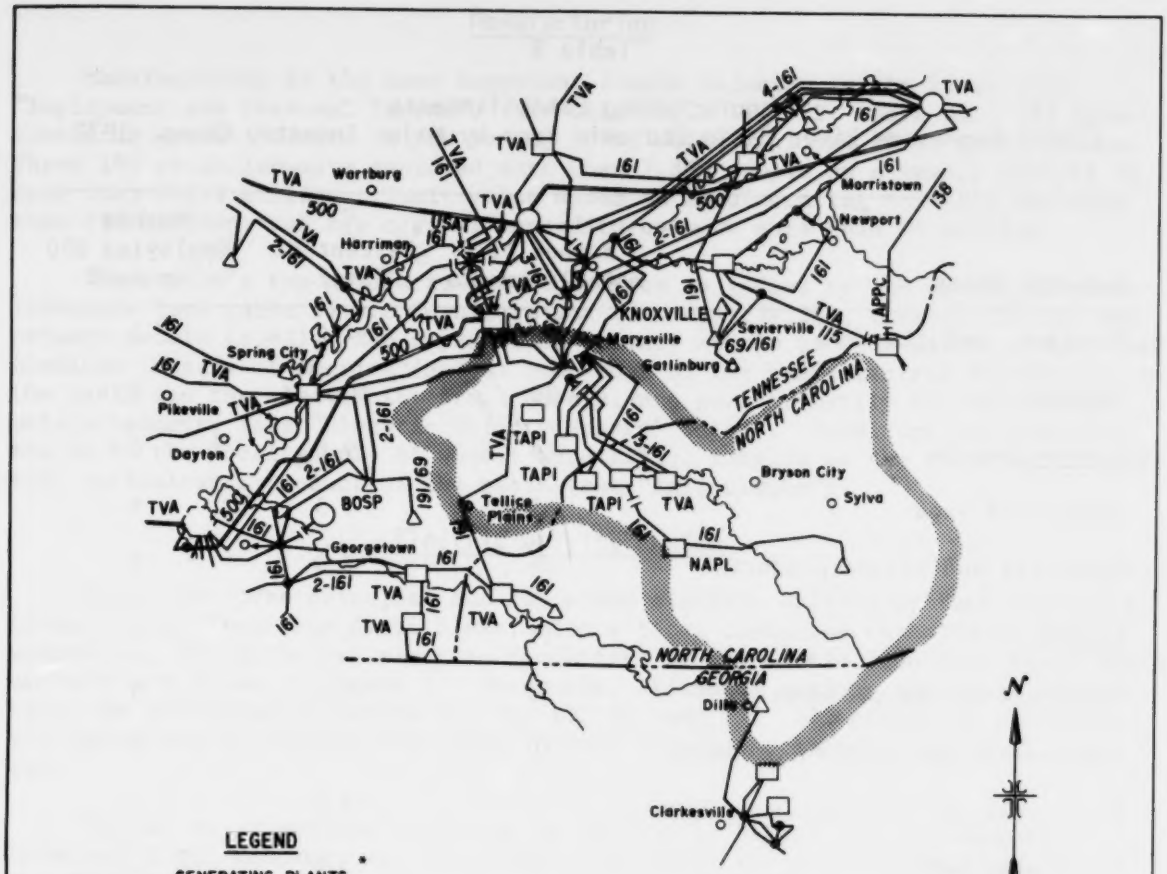
The ground and surface waters of the Little Tennessee River basin are sufficient to sustain the economy of the basin and its potential growth. Major uses include domestic, municipal, and industrial water supplies; fish and wildlife conservation; water-related recreational activities; power generation; and navigation. The computed average annual streamflow at the Tellico Dam site amounts to 5,820 cubic feet per second. The streams and aquifers of the basin are widely used for municipal and industrial water supplies. Withdrawal uses of water in the basin are discussed in chapter IV under the heading "Water Supply".

Table 9

Manufacturing Establishments
Little Tennessee River Basin Economic Area by Major Industry Group, 1972

Industry Group	Number of Establishments	Percent of Total	Number Employing 250 or more
Furniture and fixtures	68	34.2	1
Tobacco	20	10.1	0
Primary metals	19	9.6	0
Lumber and wood	15	7.5	6
Chemicals and allied products	14	7.0	0
Apparel	11	5.5	3
Paper and allied products	10	5.0	1
Instruments and related products	10	5.0	1
Electrical and electronic equipment	9	4.5	0
Fabricated metal	7	3.5	2
Transportation equipment	5	2.5	0
Leather and leather products	3	1.5	1
Machinery except electrical	3	1.5	1
Petroleum and coal products	2	1.0	0
Printing and publishing	1	0.5	0
Stone, clay, glass	1	0.5	0
Central administrative offices	1	0.5	0
Total	199	99.9[a]	16

[a]*Does not total 100% because of independent rounding of parts.*



LEGEND

GENERATING PLANTS *

Nuclear Fossil Hydro

Plant in Service

Plant under Construction

TRANSMISSION LINES

Transmission Lines (TL) 230 kilovolts (KV) (Design) or more.

TL less than 230 KV (Design) TL less than 115 KV (Design) are omitted.

Distribution Substation (all distribution substations not indicated).

345 Nominal Operating and Design Voltage (KV).

230/345 First Number (230) - Nominal Operating Voltages (KV). Second Number (345) - Nominal Design Voltage (KV).

Interconnection Between Two Utilities.

Intersecting Lines Electrically Connected.

Lines Not Electrically Connected.

River Basin Boundary (Little Tennessee River).

OWNERSHIP LIST

Utility Code	Type of Owner	Utility
TAPI	pri	Tapoco Inc.
NAPL	pri	Nantahala Power and Light
TVA	fed	Tennessee Valley Authority
GEPC	pri	Georgia Power Co.
BOSP	ind	Bowaters Southern Paper
USAT	fed	Atomic Energy Commission
APPC	pri	Appalachian Power Co.
CAPO	pri	Carolina Power and Light

* Plants having a generating capacity of less than 25 megawatts are not shown.

Principal Electric Facilities

LITTLE TENNESSEE RIVER BASIN

1981

FERC - Water Resources Appraisal For Hydroelectric Licensing Figure 2

CHAPTER IV

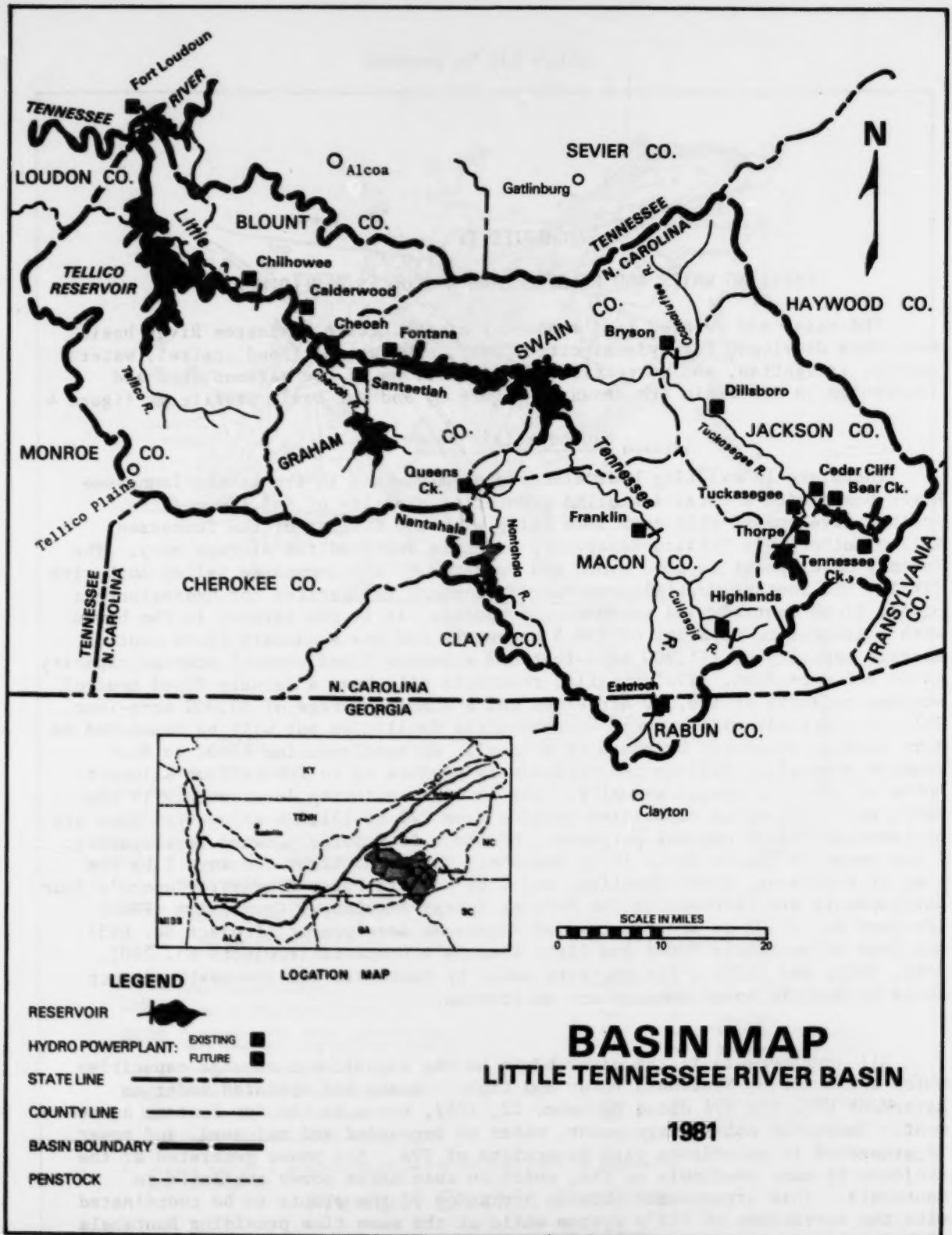
EXISTING WATER AND RELATED LAND RESOURCES DEVELOPMENT

The water and related land resources of the Little Tennessee River basin have been developed for hydroelectric power, navigation, flood control, water supply, irrigation, and recreation. The locations of the various dams and reservoirs in the basin are shown on figure 3, and the basin profile on figure 4.

Hydroelectric Power

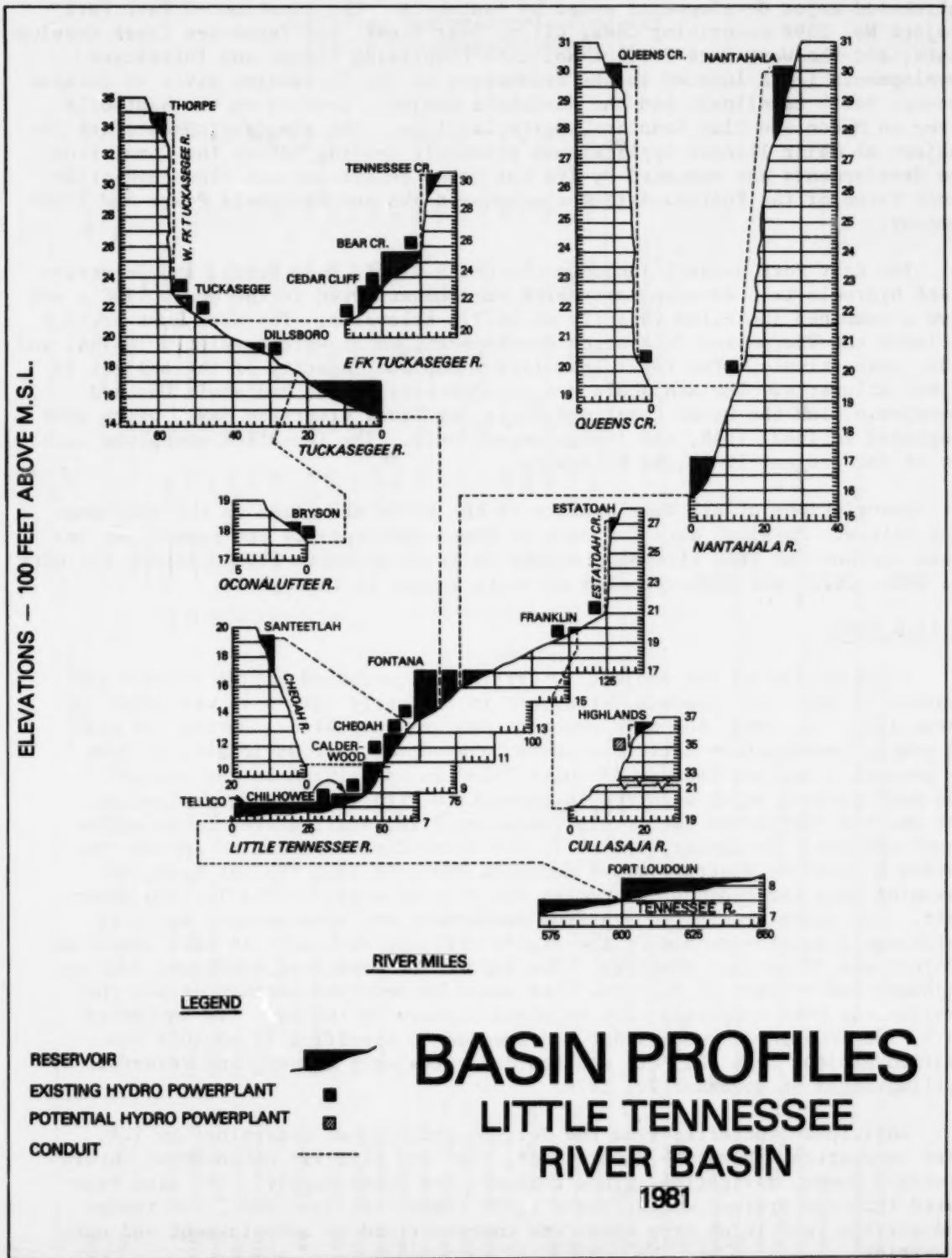
There are 17 existing hydroelectric developments in the Little Tennessee River basin with a total installed generating capacity of 663.1 megawatts. Another development will come into being with the filling of the Tennessee Valley Authority's Tellico Reservoir, which is designed for storage only. The Fontana development is also owned and operated by the Tennessee Valley Authority (TVA). The Fontana multiple-purpose development is operated for hydroelectric power, flood control, and recreation purposes. It is the largest in the basin with a generation capacity of 238.5 megawatts and has a January flood control storage capacity of 771,200 acre-feet and a summer flood control storage capacity of 21,000 acre-feet. TVA's Tellico reservoir will have a January flood control storage capacity of 126,000 acre-feet and a summer storage of 33,000 acre-feet. Tellico reservoir will have no hydroelectric facilities but will be connected to Fort Loudoun reservoir by means of a canal. By supplementing flows to Fort Loudoun powerplant Tellico can effectively produce up to 200 million kilowatt-hours of electric energy annually. The 16 other existing developments in the basin have generating capacities ranging from 225 to 121,500 kilowatts; none are operated for flood control purposes. Of these 16 privately owned developments, 4 are owned by Tapoco Inc., 10 by Nantahala Power and Light Company, 1 by the town of Highlands, North Carolina, and 1 by Georgia Power Company. Tapoco's four developments are licensed by the Federal Energy Regulatory Commission (FERC) (Project No. 2169) as are the town of Highlands development (Project No. 693), and four of Nantahala Power and Light Company's projects (Projects No. 2601, 2602, 2603, and 2694). Six projects owned by Nantahala and one small project owned by Georgia Power Company are unlicensed.

All developments in the river basin having significant storage capacities which are owned by Nantahala Power and Light Company are operated under an agreement with the TVA dated December 22, 1962, known as the New Fontana Agreement. Under the Fontana agreement, water is impounded and released, and power is generated in accordance with directions of TVA. All power generated at the projects is made available to TVA, which in turn makes power available to Nantahala. This arrangement permits operation of the plants to be coordinated with the operations of TVA's system while at the same time providing Nantahala with a power supply.



FERC - Water Resources Appraisal for Hydroelectric Licensing

Figure 3



FERC - WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING FIGURE 4

The hydroelectric projects which are detailed in this report are the six unlicensed major developments owned by Nantahala: the constructed East Fork Project No. 2698 comprising Cedar Cliff, Bear Creek, and Tennessee Creek developments; and the West Fork Project No. 2686 comprising Thorpe and Tuckasegee developments (each located in the headwaters of the Tuckasegee River in Jackson County, North Carolina); and the Nantahala project, located on the Nantahala River in Macon and Clay Counties, North Carolina. The six developments are the subject of major license applications presently pending before the Commission. The developments are operated by TVA for power generation and flow regulation under terms of the Fontana Agreements between TVA and Nantahala Power and Light Company.

The East Fork project includes the Cedar Cliff, Bear Creek, and Tennessee Creek hydroelectric developments which were constructed in the early 1950's and have a combined installed capacity of 26,175 kilowatts. The West Fork project includes the Thorpe and Tuckasegee developments which were completed in 1941 and 1950, respectively. The total installed nameplate capacity of the project is 24,600 kilowatts. The Nantahala project consists of the Nantahala Dam and powerhouse plus the Dicks Creek and White Oak Creek diversion dams, which were completed in 1942, 1948, and 1949, respectively. The installed nameplate capacity of the project is 43,200 kilowatts.

Descriptions of all developments in the basin are given in the sections that follow. Physical data for each of these developments are summarized in table 10, and the FERC licensing status is given in table 11. Data for Projects No. 2686, 2692, and 2698 are also given in tables 14 through 16.

Tellico (TVA)

Construction of the project -- originally conceived by TVA in 1936 and planned as the "Fort Loudoun Extension" in the early 1940's -- was begun in March 1967. By 1969, the main concrete dam was completed. During the next 10 years, construction activities were delayed for various lengths of time on several occasions because of suits filed in opposition to the project. The most notable delay occurred in connection with the Endangered Species Act and the listing of the Little Tennessee River snail darter as an endangered species. On January 31, 1977, the Sixth Circuit Court of Appeals reversed a previous district court decision and held that TVA was wrong in assuming that the Endangered Species Act did not apply to the Tellico reservoir. The court prohibited TVA from performing any construction activity which would destroy or modify the fish's critical habitat. At that time, the project was 90 percent complete. The injunction permitted continued work on highways and bridges in the area that would be required whether or not the project was ever completed, but enjoined closure of the dam. In September 1979, the Endangered Species Act was amended to specifically exclude the Tellico project from the Act, and the dam gates were closed, and reservoir filling began on November 29, 1979.

Anticipated benefits from the Tellico project, as determined by TVA, were recreation, shoreline development, fish and wildlife enhancement, hydroelectric power, navigation, flood control, and water supply. TVA also estimated that the project would create 4,000 industrial jobs and 2,600 trades and service jobs in an area which was characterized by unemployment and outmigration.

FERC Proj. No.	Project[a]	Owner	River Name	River Mile[k]	Drainage Area	Sto (1 Flood Control
					(sq mi)	
-	Tellico (F)	TVA	Little Tenn.	0.3	2,627	33
2169	Chilhowee (U)	Tapoco	Little Tenn.	34	1,977	-
2169	Calderwood (U)	Tapoco	Little Tenn.	44	1,856	-
2169	Cheoah (U)	Tapoco	Little Tenn.	51	1,608	-
2169	Santeetlah (U)	Tapoco	Cheoah	9	176	-
-	Fontana (F)	TVA	Little Tenn.	61	1,571	21
693	Highlands (P)	Town of Highlands	Cullasaja	18	15	-
2603	Franklin (U)	NPLC	Little Tenn.	113	310	-
2694	Queens Creek (U)	NPLC	Queens Creek	2	4	-
2601	Bryson (U)	NPLC	Oconaluftee	0.6	188	-
2602	Dillsboro (U)	NPLC	Tuckasegee	32	290	-
-	Estatoah (U)	GPC	Estatoah Cr.	2	5	-
2698	Cedar Cliff (U)	NPLC	E. Fk. Tuck.R.	2.4	81	-
2698	Bear Creek (U)	NPLC	E. Fk. Tuck.R.	4.8	75	-
2698	Tennessee Ck. (U)	NPLC	E. Fk. Tuck.R.	10	-	-
	E. Fork Dam		E. Fk. Tuck.	10.9	25	-
	Wolf Ck. Dam		Wolf Ck.	1.7	15	-
2686	Thorpe (U)	NPLC	W. Fk. Tuck.	3.4	36.7	-
2686	Tuckasegee (U)	NPLC	W. Fk. Tuck.	3.1	54.7	-
2692	Nantahala[j](U)	NPLC	Nantahala R.	13.6	108	-

[a] *F - Federally owned utility; U - privately owned utility; P - non-Federa*

[b] *For projects that are operated at varying elevations during the year for total hydroelectric power storage capacity, power pool elevation, gross for P.2698, 2686 and 2692 are given at maximum normal power pool).*

[c] *Not available.*

[d] *Highlands project is licensed for 600 kW but no provisions have been made*

[e] *Less than 500 acre-feet.*

[f] *Includes seasonal flood control storage capacity of 750,200 acre-feet.*

[g] *CG - Concrete Gravity; CG/E - Concrete Gravity/Earth Embankment; CA - Con*

[h] *Design head.*

[j] *Composite data is for Nantahala development including Dicks Creek and Whi*

[k] *River mile of powerhouse; in some cases, the dam is located several miles*

Table 10

Existing Hydroelectric Projects
Little Tennessee River Basin

age Capacity (000 ac-ft)								
b Hydro Power[b]	Dead	Surface Area[b]	Power Pool El.[b]	Gross Head[b]	Installed Capacity	Avg. Ann. Energy	Date of Initial Operation	Type[g] of Dam
		(acres)	(ft)	(ft)	(kw)	(mWh)		
93	321	17,300	815	80	-	200,000	1980	CG/E
7	42	1,750	874	68	50,000	186,000	1957	CG/E
2	39	536	1,087	213	121,500	558,000	1930	CA
2	33	595	1,277	190	110,000	449,000	1919	CG
133	25	2,860	1,940	663	45,000	164,000	1928	CA
1,136[f]	287	10,670	1,710	433	238,500	910,000	1945	CG
1	c/	c/	3,610	220	200[d]	1,200	1925	CA
e/	c/	210	2,000	26	1,040	7,600	1929	CG
0.8	e/	37	3,027	999	1,440	6,000	1949	ER
-	-	43	1,828	35	980	6,600	1925	CA
-	-	c/	1,972	12	225	1,400	1913	CG
-	-	c/	2,730	580	240	1,000	1928	CG
0.6	5.8	121	2,330	170[h]	6,375	23,200	1952	ER
4.5	30.2	476	2,560	230[h]	9,000	31,600	1954	ER
-	-	-	-	520[h]	10,800	41,600	1955	-
1.3	0.1	40	3,080	-	-	-	1955	ER
7.6	2.5	183	3,080	-	-	-	1955	ER
67.1	4.7	1,462	3,492	1,150[h]	21,600	83,300	1941	ER
-	0.1	7.9	2,279	118[h]	3,000	11,300	1950	CA
126	12.7	1,605	3,012	925[h]	43,200	236,600	1942	ER

l, publicly owned utility.

flood control, the values shown under flood control storage capacity, head, and surface area are based on operations during summer: (data

to add additional units.

crete Arch; ER - Earth and Rockfill.

e Oak diversion dams (one powerhouse).
upstream.

Table 11

Status of Hydroelectric Licensing
Little Tennessee River Basin

Plant Name	FERC Project No.	Type of Application/ License	Status	Expiration Date
Tellico (TVA)	–	–	–	–
Chilhowee[a]	2169	major	outstanding	2-28-05
Calderwood[a]	2169	major	outstanding	2-28-05
Cheoah[a]	2169	major	outstanding	2-28-05
Santeetlah[a]	2169	major	outstanding	2-28-05
Fontana (TVA)	-	-	-	-
Highlands[b]	693	minor	outstanding	7-15-81
Franklin	2603	minor	outstanding	7-30-05
Queens Creek	2694	minor	outstanding	9-30-01
Bryson	2601	minor	outstanding	7-30-05
Dillsboro	2602	minor	outstanding	7-30-05
Estatoah[c]	-	minor	-	-
Cedar Cliff[d]	2698	major	pending	-
Bear Creek[d]	2698	major	pending	-
Tennessee Creek[d]	2698	major	pending	-
Thorpe[e]	2686	major	pending	-
Tuckasegee[e]	2686	major	pending	-
Nantahala	2692	major	pending	-

[a] *Tallassee project.*

[b] *Municipal owner; license has expired; new license application filed March 14, 1980; annual license expires July 15 yearly.*

[c] *No application filed.*

[d] *East Fork project.*

[e] *West Fork project.*

Existing Water and Related Land Resources Development

The major elements of the project are a dam on the Little Tennessee River about one-quarter mile above its confluence with the Tennessee River, and a 1,000-foot-long canal through which the waters of the Little Tennessee will be diverted into Fort Loudoun reservoir on the Tennessee River, thereby enabling these waters to pass through the hydroelectric units in Fort Loudoun powerhouse. This canal enables the waters of Tellico reservoir to be used to generate electric power with the turbines at Fort Loudoun. It is anticipated that 200 million kilowatt-hours of electric energy having an estimated annual value of $400,000 will be generated annually from this flow. TVA had also evaluated the possibility of installing generating facilities at the Tellico project, since the diversion of waters through the Fort Loudoun turbines increases total energy production but does not increase peaking capacity. Economic analysis indicated that the cost of generating facilities was not justified by the gain in peaking capacity alone.

The main dam is a combination concrete-gravity and earth embankment structure 3,238 feet long and 129 feet high. The concrete portion consists of non-overflow sections on both sides of the spillway and includes three 42-foot high by 40-foot wide radial gates. The earthfill embankment has a top width of 20 feet and a freeboard of 17 feet above normal maximum pool and 12.5 feet above the headwater level during the maximum probable flood. Construction of the embankment required an estimated 1,883,000 cubic yards of fill. Three earthen, saddle dams were located on the left rim of the reservoir. They are 2,160 feet long and 36 feet high, 470 feet long and 23 feet high, and 350 feet long and 32 feet high. A 1,000-footcanal, which will divert the flow of the Little Tennessee River into Fort Loudoun Lake, was constructed on the right bank of the reservoir a short distance upstream from the dam. The canal has a bottom width of 500 feet with sides having a 3 to 1 slope. It has the capability of passing 153,000 cubic feet of water per second.

Project No. 2169

Joint application was filed on October 25, 1954, by Tapoco, Inc. of Alcoa, Tennessee, and Carolina Aluminum Company of Badin, North Carolina, for a license for FERC Project No. 2169, known as the Tallassee project, situated on the Little Tennessee River and its tributary, the Cheoah River. The Tallassee project comprises four developments: Chilhowee, Calderwood, Cheoah, and Santeetlah. A license was issued for Project No. 2169 to Tapoco, Inc., and Carolina Aluminum Company, as joint licensees, on March 17, 1955, and transferred to Tapoco, Inc., on June 30, 1955. This latter license was for the continued operation and maintenance of the constructed Calderwood, Cheoah, and Santeetlah developments and for the construction, operation, and maintenance of the proposed Chilhowee development and was issued for a period of 50 years, effective as of March 1, 1955, and is due to expire on February 28, 2005.

Chilhowee: The constructed Chilhowee development consists of a 1,410-foot-long dam on the Little Tennessee River composed of a concrete non-overflow section, a concrete intake section, a concrete spillway section, and a rock and earth non-overflow section; a reservoir of 1,750 acres at normal full water surface elevation of 874 feet; a powerhouse integral with the dam containing three turbines with total capacity of 70,000 horsepower, and three generators with total capacity of 50,000 kilowatts; a substation; an operators' village; a 161-kilovolt tie to Tapoco's 161-kilovolt transmission system; and appurtenant mechanical and electrical facilities. The maximum height of the dam from foundation level is 91 feet; however, the maximum gross head is 68 feet.

Calderwood: The constructed Calderwood development consists of a concrete arch dam about 916 feet long and 232 feet high in the Little Tennessee River; a reservoir of 536 acres at normal full water surface elevation of 1,087.5 feet; an intake structure; a concrete-lined tunnel; three penstocks; a powerhouse about one-half mile below the dam containing three turbines each rated at 56,000 horsepower and connected to a 40,500-kilowatt generator; a substation; an operators' village; a double-circuit telephone line to Alcoa and a carrier system on the transmission lines; a 161-kilovolt tie to Tapoco's 161-kilovolt transmission system; and appurtenant mechanical and electrical facilities.

Cheoah: The constructed Cheoah development consists of a concrete-gravity dam about 750 feet long and 225 feet high in the Little Tennessee River; a reservoir of 595 acres at normal full water surface elevation of 1,276.5 feet; an intake structure; a concrete-lined tunnel; five penstocks; a powerhouse a short distance below the dam containing four turbines each rated at 33,000 horsepower and connected to a 20,000-kilowatt generator, and one 45,000-horsepower turbine connected to a 30,000-kilowatt generator; a substation; an operators' village; a double-circuit telephone line to Calderwood and a carrier system on the transmission line; a 161-kilovolt tie to Tapoco's 161-kilovolt transmission system; and appurtenant mechanical and electrical facilities.

Santeetlah: The constructed Santeetlah development consists of a concrete arch dam about 1,054 feet long and 212 feet high, in the Cheoah River; a reservoir of 2,863 acres at normal full water surface elevation of 1939.9 feet; an intake structure; a conduit about 25,176 feet long composed of concrete-lined tunnel and steel pipe; two penstocks; a powerhouse on the Little Tennessee River discharging into the Cheoah reservoir containing two turbines each rated at 33,000 horsepower and connected to a 22,500-kilowatt generator; a substation; a 161-kilovolt tie to Tapoco's 161-kilovolt transmission system; and appurtenant mechanical and electrical facilities.

Fontana (TVA)

The Fontana Dam is located in the Great Smoky Mountains 61 miles upstream from the mouth of the Little Tennessee River in western North Carolina about 10 miles east of Deals Gap. The Fontana Dam project was designed and constructed as one of the significant multiple-purpose units in TVA's unified program for the development of the Tennessee Valley.

Fontana Dam is a gravity-type concrete structure 480 feet high, 2,365 feet long, and about 375 feet thick at its base. It extends straight across the river gorge and seals against bedrock. Construction began January 1, 1942; closure of the dam was made November 7, 1944; and the first of three 67,500-kilowatt generating units was placed in operation January 20, 1945. Unit Nos. 1-3 were rewound in 1969-76 and their capacities were increased to 81,000, 76,500, and 81,000 kilowatts, respectively.

The powerhouse is located in the natural river bed at the toe of the dam. The structure is of reinforced concrete throughout and is the enclosed type. The adjoining switchyard includes the main transformers, breakers, and switches for the transmission lines. The hydraulic turbines are of the vertical-shaft Francis type and are rated at 91,500 horsepower at a 330-foot head. Each unit discharges 2,600 cubic feet per second at rated head and capacity. Their normal speed is 150 revolutions per minute. Each turbine receives water from the reservoir through a 14 foot-diameter steel lined conduit embedded in the dam, terminating in a spiral steel scroll case and elbow-type draft tube.

Fontana reservoir, with a total flood control and power storage capacity of 1,157,300 acre-feet (including a maximum seasonal flood control storage of 771,200 acre-feet), gives a high degree of control of floods from the 1,571 square miles of drainage area, and along with Tellico constitutes a major part of the flood control facilities of the Tennessee Valley. The reservoir receives extensive recreational use.

Highlands (Project No. 693)

On May 24, 1976, the Town of Highlands, licensee for FERC Project No. 693, located in Macon County, North Carolina, filed an application for a new license under the Federal Power Act and Commission Regulations. The project had been under license since July 16, 1926, for a period ending July 15, 1976. The project is currently licensed under section 15 of the Act on an annual basis and is not subject to the recapture provisions of section 14 of the Act because it is owned by a "municipality."

The project is located partly on Federal lands within the Nantahala National Forest, approximately 2.5 miles northwest of the Town of Highlands. It consists principally of a concrete arch dam about 200 feet long with a maximum height of about 35 feet on the Cullasaja River, a small reservoir, a steel conduit extending from the dam to a downstream powerhouse having an installed capacity of 200 kilowatts, and a 69-kilovolt transmission line from the powerhouse to the Town of Highlands. The static head available is about 220 feet.

The project has not produced power since 1968 due to mechanical failure of the generating unit. The Town of Highlands is at present renovating the project. The renovation will include increasing the generation capacity to 700-750 kilowatts and is estimated to cost about $636,000. A commitment for 50 percent of the cost has been made by the Appalachian Regional Commission, and the remainder is to be secured by sale of bonds.

Franklin (Project No. 2603)

The Franklin project (FERC Project No. 2603) is in Macon County, North Carolina, about 2.5 miles north of Franklin, North Carolina. It was constructed in 1925 by the Town of Franklin, and was sold in 1933 to the Nantahala Power and Light Company. The maximum normal water surface elevation was increased 1 foot by adding extensions to the steel flood gates on the spillway. Work was started July 16, 1942, and was completed April 9, 1943. The Nantahala Power and Light Company filed an application for a minor license on June 29, 1966, for the constructed project. The application was supplemented on August 5, 1970, November 12, 1970, and August 18, 1977. The license was issued on July 31, 1980, and will expire on July 30, 2005.

The Franklin development includes a powerplant with two units rated at 520 kilowatts each and a 210-acre reservoir. The dam and powerhouse are located on the Little Tennessee River at river mile 113.1. The existing project consists of (1) a concrete-gravity dam about 460 feet long and about 30 feet high with abutment sections totaling about 87 feet in length; two overflow sections having four bays, each 25 feet long, in a length of 104 feet; six Tainter gates, each 25 feet wide by 10 feet deep, in a length of 18.5 feet; a non-overflow section about 25 feet long containing a trash sluice 4 feet wide and 5 feet deep; and an intake section about 63.3 feet long with three turbine bays; (2) a reservoir at elevation 2,000.22 feet, about 4.6 miles long with a surface area of about 210 acres, and with little usable storage capacity; (3) a concrete-brick powerhouse containing two generating units, each rated at 520 kilowatts, totaling 1,040 kilowatts; and (4) appurtenant facilities.

Queens Creek (Project No. 2694)

The Nantahala Power and Light Company constructed the Queens Creek project. Construction began in July 1947. Closure of the dam was accomplished on December 27, 1948, and the powerplant started operation on January 28, 1949. The company filed an application for a minor license on January 2, 1969, for the constructed Queens Creek project (FERC Project No. 2694). The application was supplemented on March 28, 1969, October 26, 1972, and June 14, 1979. The FERC issued an order granting a license on October 20, 1976 for a period expiring on September 30, 2006, but the applicant took exception to certain provisions of the license and on November 19, 1976, filed an application for rehearing, reconsideration, and clarification. On December 17, 1976, the FERC issued an order granting a rehearing; however, the matter in contention related primarily to the term of license and has been resolved.

The Queens Creek project is located in Macon County, North Carolina, about 17 miles northwest of Franklin. The dam is located on Queens Creek at creek mile 1.5, and the powerhouse is located on the Nantahala River at river mile 13.5. A spillway, 135 feet wide, is excavated into rock in the left abutment. The existing Queens Creek project consists of an earth and rockfill dam 78 feet high and 382 feet long creating a reservoir having an area of 37 acres at normal pool elevation of 3,027 feet with usable storage capacity of 778 acre-feet; a side channel spillway excavated in rock containing an earth fuse plug dam in two sections, a pilot section with crest at elevation 3,028 feet and the remaining section with crest at elevation 3,030 feet; a low level conduit through the dam to a wye, one branch of which serves as an intake to the 24-inch diameter, 6,600-foot-long penstock and the other as a reservoir drain; a powerhouse containing one 1,440-kilowatt generator; and appurtenant facilities.

Bryson (Project No. 2601)

The Bryson project, which lies adjacent to the Cherokee Indian Reservation, was constructed by the town of Bryson City and began operation in 1925. In 1942, it was sold to the Nantahala Power and Light Company along with all appurtenant facilities. One foot of concrete was added to the crest of the overflow spillway of the Bryson Dam, increasing the maximum normal water surface elevation 1 foot. Work was started July 21, 1943, and was completed October 30, 1943. The Nantahala Power and Light Company filed an application for a minor license on June 29, 1966. The license was issued on July 31, 1980, and will expire on July 30, 2005.

The Bryson development (FERC Project No. 2601) is in Swain County, North Carolina, about 5 miles east of Bryson City. The project includes a concrete multiple-arch dam, gated ogee spillway, and a powerhouse on the Oconaluftee River at river mile 0.6. The output of the powerplant is fed into Nantahala's 69-kilovolt transmission system, which is directly adjacent to the project.

Project works consist of a concrete dam about 315 feet long and 35 feet high in four sections having a non-overflow gravity section 51.5 feet long, a gated section 43.5 feet long with two 16-foot by 16.5-foot Tainter gates, an overflow section 156 feet long having a crest elevation of 1,828.4 feet and an intake section 64.5 feet long; a reservoir at elevation 1,828.4 feet about 1.5 miles long with little usable storage capacity; a concrete and brick powerhouse, 62 by 26.5 feet containing two vertical generating units rated at 480 and 500 kilowatts totaling 980 kilowatts; and appurtenant facilities.

Dillsboro (Project No. 2602)

The first dam at the Dillsboro site was constructed prior to 1909 to furnish mechanical power for a mill. The site and property was acquired in 1909 by Mr. C. J. Harris who was President of Dillsboro and Sylva Electric Light Company. Harris constructed the power project, which was placed in operation about 1913. He sold the entire project to Dillsboro and Sylva Electric Light Company in 1934. Nantahala Power and Light Company purchased the project, together with its transmission and distribution properties and related facilities in 1957, after having secured the approval of the FPC. Shortly after purchasing the project, Nantahala raised the height of the overflow crest of the spillway 2 feet to increase the maximum normal water surface elevation by 2 feet. This construction began about October 15, 1957, and was completed December 31, 1957. The Nantahala Power and Light Company filed an application for a minor license on June 29, 1966, for the constructed Dillsboro project. The application was supplemented on August 5, 1970, November 12, 1970, and August 18, 1977.

The Dillsboro project (FERC Project No. 2602) is located in Jackson County, North Carolina, within the city limits of Dillsboro. The project includes a 12-foot-high concrete gravity dam, a 225-kilowatt powerplant, and a reservoir on the Tuckasegee River, 31.5 miles above its mouth.

The existing project consists of a masonry-concrete gravity dam about 330 feet long and 12 feet high in six sections having abutments totaling about 20 feet in length, an overflow spillway 14 feet long, a gated section 20 feet long containing two sluice gates 6 feet wide and 11 feet deep, a spillway 197 feet long, an intake section about 47 feet long, and a powerhouse section about 32 feet long; a reservoir at elevation 1,972 feet, about 0.8 miles long and with little usable storage capacity; a wood-frame, corrugated-iron powerhouse containing two vertical generating units at 175 and 50 kilowatts, totaling 225 kilowatts; and appurtenant facilities. The license was issued on July 31, 1980, and will expire on July 30, 2005.

Estatoah (Unlicensed)

The Estatoah development is unlicensed and is owned and operated by the Georgia Power Company. It began operation in 1928. The project includes a 12-foot-high masonry gravity dam 70 feet long, a 240-kilowatt powerplant, and a small reservoir on Estatoah Creek with a drainage area of 5 square miles at

creek mile 1.7 developing a gross head of 624 feet and a design head of 580 feet. The average annual power generation of the project is about 1,000 megawatt-hours.

Navigation

Tellico reservoir will extend 33 miles upstream to the foot of Chilhowee Dam, and a minimum 9-foot-deep navigation channel will be created up the Little Tennessee River for a distance of about 30 miles. The canal connecting Tellico with Fort Loudoun reservoir will open Tellico reservoir to commercial navigation from the Tennessee River. On the Tellico River, commercial traffic will be limited to the lower 3.5 miles because of bridge clearances.

TVA studies indicate there are no other areas in the Tennessee Valley upstream from Chattanooga that have potential for industrial development that approaches that of the area downstream from river mile 20 on the Little Tennessee River. Very substantial development occurs at places where water, rail, and highway transportation and a suitable land base are available. Rail service to the Tellico project area is generally good and highway connections between the project area and the region will be good following completion of the project. The Tellico project will bring commercial navigation to several thousand acres of land along its shores. With the addition of navigation improvements, these lands will become more favorably situated for industrial development than any other areas in the portion of the Tennessee River basin upstream from Chattanooga.

Flood Control

The generous rainfall in the Little Tennessee River basin is reflected in the contribution of this basin to Tennessee River floods. The peak rates and total volumes of flood flows at Chattanooga are substantially affected by the discharge of the Little Tennessee River. The Fontana project and the Tellico project are two TVA multiple-purpose projects that provide for flood control. Other hydroelectric power projects described in this chapter provide incidental flood control and, together with the Fontana and Tellico projects, serve to reduce flood flows downstream.

The largest development in the basin is TVA's Fontana Dam, located at river mile 61.0 on the Little Tennessee River. Fontana controls a drainage area of 1,571 square miles, or 60 percent of the total drainage area of the entire basin. It has a controlled flood control storage reservation of 771,200 acre-feet available on January 1 of each year. The reservoir, with 1,157,300 acre-feet of usable controlled storage capacity, provides practically complete stream-flow regulation to the downstream Cheoah, Calderwood, and Chilhowee generating plants.

The greatest actual and potential damage from floods in the Tennessee Valley has been in Chattanooga, which is only partially protected by the TVA reservoir system. The flood control storage capacity of Tellico reservoir will aid substantially in operating the system to reduce flood crests at Chattanooga and in reducing damages to smaller communities and agricultural lands along the Tennessee River between Chattanooga and the project. The Tellico reservoir will provide flood control storage amounting to 33,000 acre-feet in summer and 126,000 acre-feet in winter.

During the winter flood season, the Tellico reservoir would be operated at near minimum level to provide the greatest amount of flood storage capacity available in the reservoir. Between normal minimum pool at elevation 807 and the maximum controlled reservoir surface at elevation 815, the reservoir will add 126,000 acre-feet of controlled flood control storage capacity to the TVA flood control system. In the event the maximum probable flood should occur, the reservoir may reach a level as high as elevation 817.5 at the dam.

Water Supply

The water supply needs of the basin are amply provided for by the Little Tennessee River system. There were 14 water supply systems in the basin serving about 12,000 people in 1960 and providing about 4.3 million gallons per day. About 81 percent of the total was from surface streams, the remaining 19 percent came from wells and springs. A study of the area indicate that surface water supplies throughout the basin are still adequate to meet the current and future water requirements of the basin population. The abundance of surface water resources precludes any need to develop alternative sources.

Water Quality

Available data from periodic studies indicate that the water quality in the Little Tennessee River basin is generally good. Fecal coliform contamination was found to be the only significant water quality problem in the basin. High fecal coliform levels were noted in the Little Tennessee River above Fontana reservoir and in the Cheoah River below Robinsville. The two major water recreation areas, Fontana reservoir and Santeetlah Lake, were found to be free of fecal coliform contamination and satisfactory for water recreation activities.

A primary water quality monitoring network consists of 10 fixed stations in North Carolina on the main stem or major flowing streams of this drainage area and on major tributaries to those streams. This network is maintained to collect data on the present status of water quality and evaluate historical trends in water quality for the Little Tennessee River watershed.

The data from each station, which was collected from June 1976 to December 1977, has been evaluated by the following parameter groups:

Harmful Substances	Cadmium, total chromium, cobalt, copper, iron, lead, manganese, mercury, zinc, arsenic, pesticides
Physical modifications	Temperature, turbidity, suspended and total solids, Secchi Disk.
Salinity, acidity, and alkalinity	pH, alkalinity, specific conductance, salinity.
Oxygen depletion	Dissolved oxygen, Kjeldahl nitrogen, ammonia, COD, BOD.
Health hazard	Fecal coliform, total coliform.

The existing water quality is described in the following terms:

Poor	Pollutants were found to be in excess of recommended levels (by the North Carolina Environmental Management Commission) most of the time.
Fair	Pollutants were found to be in excess of recommended levels some of the time.
Good	Pollutants were seldom found to be in excess of recommended levels, but slight degradation was noted.
Excellent	Pollutants were never found in excess of recommended levels, and no degradation was noted.

A summary of water quality from the 10 sampling stations in the river basin for the indicated period is shown in the following tabulation.

	No. of Stations			
Parameter Group	Poor	Fair	Good	Excellent
Harmful substances	0	0	10	0
Physical modifications	0	0	2	8
Salinity, acidity	0	0	4	6
Oxygen depletion	0	0	0	10
Health hazard	0	1	5	4

The water of the Little Tennessee River in the Tellico project area is of excellent quality in all respects. When studied in 1964, water temperatures in the Little Tennessee River ranged from a summer high of 62 degrees Fahrenheit to a winter low of 42 degrees. By contrast, temperatures ranged from 87 to 43 degrees Fahrenheit in unregulated streams in the area, while the normal range of temperatures in Fort Loudoun reservoir is from 87 to 39 degrees. The water is quite soft, clear, low in minerals, and high in dissolved oxygen. In conjunction with TVA's study of water quality in Fort Loudoun reservoir in 1971, the concentrations of fecal coliform bacteria found in monthly samples at Little Tennessee River mile 0.3 collected between January and November were far below the 1,000 fecal coliforms per 100 milliliters allowed in the water quality standards of the State of Tennessee for water-contact sports.

In the upper and central portions of the Tellico reservoir, which will not be affected by inflow through the canal, turbidity, hardness, mineral concentrations, and coliform bacteria counts are expected to remain about the same. The temperature of the water near the surface of the reservoir will remain the same in the upper reaches. Downstream from about river mile 30, summer temperatures near the surface will begin to increase to a high of about 87 degrees. No change in winter low temperatures is anticipated. The summer temperature increase should favorably affect the recreation potential of the reservoir for water contact use. Dissolved oxygen levels should remain high, except that, as is the case in most reservoirs in the region, water in the lower layers of the reservoir is expected to be low in dissolved oxygen during the summer and fall months. Because all discharges from the reservoir will consist of waters from

the upper 23 feet through the canal (and, during high flow conditions, over the spillway), the temporary dissolved oxygen deficiency of the lower waters will be of no significance.

The effect of reverse canal flows will be to bring water from Fort Loudoun reservoir into the lower reaches of Tellico reservoir. Since the quality of water in Fort Loudoun reservoir near the canal is quite good, no significant impact on water quality in Tellico reservoir is anticipated from such reverse flows. The water flowing into Tellico reservoir from Fort Loudoun reservoir will be warmer during summer and fall months and will at all times have somewhat higher mineral concentrations. It will have about the same clarity and level of dissolved oxygen. During the study of water quality in Fort Loudoun reservoir in 1971, the concentrations of fecal coliform bacteria in this portion of the reservoir were lower than those near the mouth of the unimpounded Little Tennessee River. The impoundment of the Little Tennessee River and diversion of its waters through Fort Loudoun reservoir is expected to increase concentrations of dissolved oxygen discharged at Fort Loudoun Dam during the summer months.

Water discharged from Chilhowee Dam on the Little Tennessee River at Mile 33.5 is of excellent quality in all respects. It is quite cold all year, very clear, and quite soft. It averages only 15 to 20 milligrams per liter total hardness. It is very satisfactory for municipal, industrial, and agricultural water supply uses, and for recreational uses.

Steam-Electric Facilities

There are no steam-electric plants in operation in the Little Tennessee River basin at the present time, and none are currently planned.

Recreation

Primary recreational activities within the Little Tennessee River basin are divided among reservoir-oriented and stream-oriented pursuits. Reservoir recreational activities are mainly fishing, boating, and waterskiing. Some swimming, sunbathing, lake canoeing, picnicking, camping, and hunting also occur. The streams are mostly used for trout fishing. The streams are also used for rafting, canoeing, and kayaking but to a limited extent. For example, in the stretch of the Little Tennessee River to be inundated by the Tellico project, canoers and rafters total less than 5 percent of the recreational users.

The hydroelectric project reservoirs provide alternatives to the recreational activities provided by the streams. Additionally, recreational users of the reservoirs greatly outnumber those that use the streams. For instance, the projected use of the Tellico reservoir is more than 40 times the current use of that portion of the Little Tennessee and Tellico Rivers to be inundated (more than one million annual visitors). It is estimated that 90 percent of the fishermen in east Tennessee use the reservoirs.

All of the reservoirs attract recreational users, with most having recreational facilities or at least access sites developed and/or planned. Recreational information for the existing hydroelectric projects in the Little Tennessee River basin is summarized in table 12.

Table 12

Summary of Recreational, Fish, and Wildlife Aspects of Existing Hydroelectric Facilities, Little Tennessee River Basin

Reservoir[a]	State	Stream	Size	Access	Recreational Use	Recreational Development	Trout Stocking	Minimum Flow	Reservoir Fishery	Comments
			(acres)					(cfs)		
Queens Creek	NC	Tributary of Nantahala River	37	Narrow winding unpaved road	Little; primarily bank fishing and fishing from small boats. Picnicking, canoeing, and kayaking taught in summer.	No	Yes	0	Rainbow trout	Some silting at upper end, little hunting and waterfowl use.
Franklin	NC	Little Tennessee River	210	Adequate to reservoir	Some fishing below project. Utilization of reservoir is low.	No	No	70	Few game fish including small sunfish	Reservoir practically silted in. Storm drainage runoff and Franklin City sewage treatment plant probably degrade reservoir water quality. Project lands too limited in area to offer appreciable hunting or wildlife management.
Dillsboro	NC	Tuckasegee River	~0.8 miles long	One undeveloped, seldom-used boat launch	River downstream of project used for canoeing, kayaking, rafting, and fishing. Little usage of reservoir by bank fishermen.	No	No	130	Catfish, carp, largemouth bass, sunfish	Silted. Little hunting as project is in urbanized area.
Bryson	NC	Oconaluftee River	45	One undeveloped boat launch area	Little fishing and hunting use.	No	No	82	Smallmouth bass, rock bass, trout	Almost silted in. Little recreational use due to steep terrain, lack of roads, and parking areas.
Santeetlah	NC	West Buffalo Creek of Cheoah River	2,863	Adequate	Fishing from small boats.	Yes	Yes	-[b]	Trout and warmwater fishery	
Chilhowee	TN	Little Tennessee River	1,690	Three concrete boat launching ramps made by Tennessee Game and Fish	Fishing, boating, waterskiing, picnicking, camping.	Yes	Yes	-	Trout and warmwater fishery	Hunting allowed except along section fronting Great Smoky Mountains. Boat screen barriers to prevent access to Great Smoky Nat'l Park by boat. Threadfin shad stocked for forage. State manages boat launching, picnicking, sanitary, and drinking water facilities.
Calderwood	TN	Little Tennessee River	536	Adequate	Fishing and hunting.	Yes	Yes	-	Trout and warmwater fishery	
Cheoah	NC	Little Tennessee River	629	Adequate for user level	Fishing and hunting.	Yes	Yes	-	Trout and warmwater fishery	
Highlands	NC	Cullasaja River	-	Difficult due to terrain	Fishing mostly by private land owners. Trout fishing below project.	No	-	-	Warmwater fishery	
Fontana	NC	Little Tennessee River	10,670	Adequate	Fishing, boating, swimming, picnicking, hiking, hunting.	Yes	-	-	Crappie, bass, bluegill, pike	Project area has more than 40 times more use than occurred prior to impoundment. Limited waterfowl use.
Tellico	TN	Little Tennessee River	16,500	Adequate	Fishing, boating, skiing, picnicking, hunting.	Yes	Yes	-	Sauger, crappie, sunfish, bass, probably trout	Use is anticipated to be more than 5 times present area use, with estimates of 2 million visitors per year. Hunting estimated at 800 man-days for small game and 100 to 200 for waterfowl.

[a] *The small Estatoah reservoir in Georgia on the Little Tennessee River is not included due to lack of information. Its recreational use is probably limited to a warmwater fishery due to its small size.*

[b] *Dash indicates that no information was available.*

Additional scenic and recreational opportunities abound in the Little Tennessee River basin. Much of the area is within the Great Smoky Mountains National Park, the Cherokee National Forest, the Cherokee Indian Reservation, and the Nantahala National Forest.

Fish and Wildlife

The impounding of rivers by hydroelectric facilities is often looked at as destructive to fish and wildlife, e.g., construction of Chilhowee inundated shoals and food-producing areas within an exceptionally good trout water habitat. Creation of reservoirs also inundates wildlife habitat. However, several positive impacts to fish and wildlife also occur as a result of hydroelectric development. Prior to hydroelectric development in the Little Tennessee River basin, erosion control techniques were not highly developed or utilized by the lumber and agricultural industries that existed in the watershed. Stream reaches downstream of many of the projects have become clear, coldwater habitats suitable for stocking with trout species. The dams produce less turbid streams due to the silt retention capabilities of their reservoirs. Hydroelectric facilities have also added to the overall habitat diversity within the region, without causing drastic environmental consequences. For example, over 80 percent of the streams in Tennessee that drain over 25 square miles remain unimpounded.

Fishing and hunting contribute to the recreational use of the Little Tennessee River basin. Fishing is good to excellent within most of the basin, while hunting is good (although not highly developed in the hydroelectric project areas). Water quality is good throughout most of the basin. A coldwater (trout) fishery exists in many of the reaches downstream of the hydroelectric projects, and reservoirs support a warmwater fishery. Many of the reservoirs have a two-story fishery, i.e., warmwater species inhabiting surface waters and coldwater species lower reservoir levels. Many of the reservoirs have year-round temperatures which are too cold for the traditional species of fish.

The fish fauna in the Little Tennessee River basin is diverse; there are approximately 90 species. Sport fishing is principally for trout (rainbow, brook, and brown), walleye, sauger, white bass, smallmouth and largemouth bass, white and black crappie, and a variety of sunfish species. Commercial fishing is not significant in the basin. The States stock trout in most of the reservoirs and major trout streams of the basin. The impoundments have short plankton-to-fish food chains, but despite the paucity of benthic invertebrates the reservoir fishery is often 50 times more productive than that of unimpounded rivers. Shallow overbank areas become colonized seasonally by macroinvertebrates.

Wildlife abounds within the Little Tennessee River basin. Approximately 60 species of mammals are recorded from the Great Smoky Mountains National Park. Big game animals are black bear, whitetail deer, wild boar, and wild turkey. Small game animals include: bobwhite, cottontail rabbit, fox and gray squirrels, groundhog, opossum, raccoon, red fox, ruffed grouse, mourning dove, and woodcock. Among the furbearers are bobcat, gray fox, mink, muskrat, skunk, weasel, and groundhog. Deer were rare in the area before 1936, but now number about 150,000. TVA wildlife management techniques have also made quail, turkey, squirrel, and other wildlife more abundant in comparison to the early 1900s. Some small game hunting and trapping occur within the vicinity of various projects, but most hunting occurs away from the projects, and big game hunting is mainly limited to government game protection areas. Birds are also very abundant in the Little

Tennessee River basin. At least 25 species of ducks and waterbirds, 26 species of shore and wading birds, and 155 species of avian predators and songbirds are temporary (migrant) or permanent residents of the larger impoundments in the TVA region. Nearly a quarter of a million ducks now visit the Tennessee Valley, which was barren of waterfowl prior to 1930. Waterfowl hunting is limited to temporary use in most of the reservoirs due to poor habitat resulting from water level drawdowns.

Of the existing hydroelectric projects in the Little Tennessee River basin, Tellico has received the greatest environmental notoriety due to the snail darter issue. Prior to final dam closure, transplantation efforts were conducted to remove the remaining adult snail darters to the Holston River, with juvenile darters going to a Tennessee Wildlife Resources Agency hatchery until summer. A population transplanted in 1975 to the Hiwassee River is known to be reproducing, but it is still too early to know if it will become permanently established. Some pairs were taken to a TVA lab to study methods of raising the snail darters in hatcheries.

General information regarding fish and wildlife aspects of the existing projects is summarized in table 12.

CHAPTER V

THE EAST FORK PROJECT

The East Fork project, located on the East Fork of the Tuckasegee River and its tributaries in Jackson County, North Carolina, is owned and operated by the Nantahala Power and Light Company. The East Fork project (FERC Project No. 2698) includes the Cedar Cliff, Bear Creek, and Tennessee Creek hydroelectric developments. These developments were constructed in the early 1950s under the authorization of the Federal Power Commission (FPC), Tennessee Valley Authority (TVA), and the North Carolina Utilities Commission. They have a combined installed capacity of 26,175 kilowatts and have generated an average of 96,400 megawatt-hours of energy per year since 1955. On February 27, 1969, Nantahala Power and Light Company submitted its application to the Federal Power Commission for a license to continue operation and maintenance of the existing project for generation of hydroelectric power.

History

Dates of the major events for each development in the East Fork project are tabulated below:

Development	Construction Started	Closure of the Dam	Commercial Operation Started
Cedar Cliff	10/50	4/26/52	8/22/52
Bear Creek	1/52	10/8/53	4/14/54
Tennessee Creek			
Wolf Creek Dam	10/52	3/22/55	5/19/55
East Fork Dam	10/52	4/18/55	5/19/55

The East Fork project is subject to control by TVA under the provisions of section 26a of the Tennessee Valley Authority Act of 1933 as amended. This section requires TVA to exercise control to achieve the best utilization of available water resources, and requires pre-construction approval by the TVA Board of any obstruction within the Tennessee River system. In addition to this general authority over the development of the streams, TVA has more direct control under an agreement with Nantahala dated December 22, 1962, known as the New Fontana Agreement, which in part superseded an earlier agreement (August 16, 1941). Under the Fontana Agreement, water is impounded and released, and power is generated in accordance with the directions of TVA. All power generated at the project is made available to TVA, which in turn makes power available to the Nantahala Power and Light Company in accordance with the Agreement.

On March 16, 1949, before such construction was commenced, Nantahala Power and Light Company of Franklin, North Carolina, a North Carolina corporation,

filed the requisite declarations of intention with the FPC pursuant to section 23(b) of the Federal Power Act. By final findings issued on September 9, 1949, the Commission found that "the interests of interstate or foreign commerce would not be affected by the construction and operation of the proposed developments."

In July 1965, after the decision of the Supreme Court in the "Taum Sauk" case, FPC v. Union Electric Company, 381 U.S. 90 (1965), the Commission advised Nantahala of its general policy decision to require a license for all existing hydroelectric developments that affect interstate commerce. Because Nantahala's hydroelectric projects had previously been authorized under sections 23(b) of the Act, Nantahala filed in November 1965, a petition for a Declaratory Order to clarify this matter. By an order issued pursuant to section 4(g) and 309 of the Act, dated July 18, 1966, the Commission held that licenses were required, and directed the filing of applications. The Commission's Order was upheld by the reviewing courts. Nantahala Power and Light Company v. FPC 384 F. 2d 200 (1967), cert den., 390, U.S. 945 (1968). Therefore, on March 4, 1969, Nantahala filed an application for a major license to authorize the continued operation and maintenance of its constructed East Fork project.

Public Law 91-224 of the United States requires that a certificate of water quality be filed with each application for license. By letter dated October 23, 1972, Nantahala submitted its certification dated October 9, 1972, from the North Carolina Board of Water and Air Resources.

Description of Physical Works

The East Fork project involves the operation and maintenance of four dams and reservoirs, totaling about 14,000 acre-feet of usable storage capacity; and four tunnels and three powerhouses with associated electrical transmission facilities. Construction of new transmission facilities is not planned. The Tennessee Creek development, consisting of a dam and reservoir on Wolf Creek and a dam and reservoir on East Fork, has a total usable power storage capacity of 8,890 acre-feet. Bear Creek, the middle development, has a total usable power storage capacity of 4,536 acre-feet. Cedar Cliff, which is downstream from the Bear Creek development, has 585 acre-feet of power storage capacity. Pertinent data for the East Fork developments are given in tables 10-13. A general map of the project area is shown on figure 5. Photographs are presented as figures 6 through 9.

Cedar Cliff

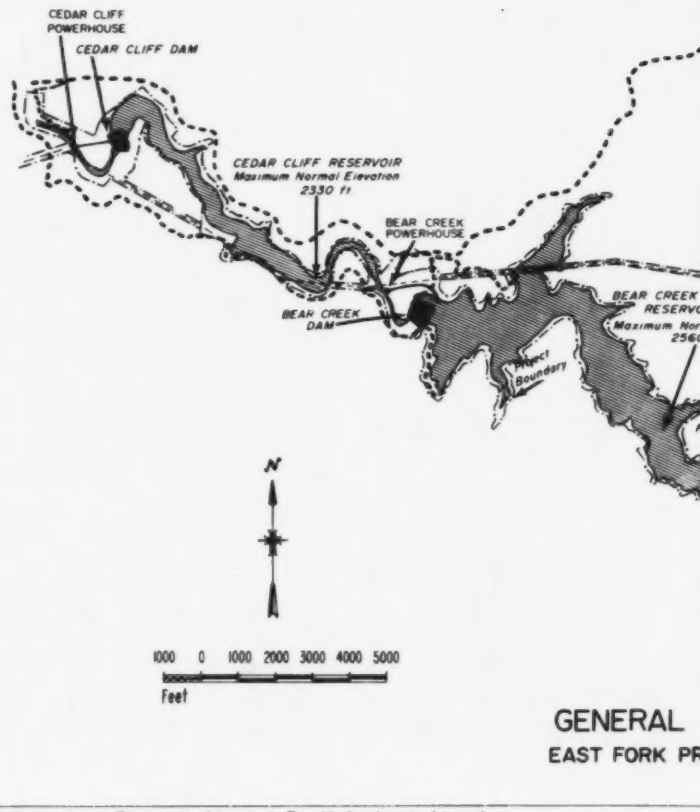
The Cedar Cliff development is the lowermost development and includes a dam at river mile 2.4 (approximately 11 airline miles southeast of Sylva, North Carolina). The dam, which is 590 feet long with a maximum height of 173 feet, is of rock-fill construction with a sloping earth core. The crest of the dam at the right and left ends is at elevation 2,340 feet, which is about 10 feet above normal full pool. There are two spillways which were excavated in the rock abutments. They contain a 25-foot square float-controlled, electrically operated Tainter gate in the right abutment and a 221-foot fuseplug across a rock channel in the left abutment. The Cedar Cliff Dam impounds a reservoir which covers an area of 121 acres at maximum normal elevation (top of gates) 2,330 feet. The usable storage capacity is 585 acre-feet between 2,330 feet and 2,325 feet, and the total storage is 6,400 acre-feet. Design flood control pool at elevation

Table 13

Pertinent Data, East Fork Project
Little Tennessee River Basin

General				
Plant name	Cedar Cliff	Bear Creek	Tennessee Creek	
River	East Fork of Tuckasegee	East Fork of Tuckasegee	East Fork of Tuckasegee	Wolf Creek
River mile	2.4	4.8	confluence of Wolf Creek and the East Fork of Tuckasegee	
Drainage area, sq mi	80.7	75.3	24.9	15.2
Mean flow, cfs	225	225	78	47
Primary purpose	power production	power production	power production	power production
Dam				
Type	earth and rockfill	earth and rockfill	earth and rockfill	earth and rockfill
Max. height, ft	173	215	140	180
Length, ft	590	760	385	810
Spillway				
Design flood, cfs	60,000	60,000	35,000	27,000
Crest of spillway[a]	2,305	2,535	3,061	3,061
Freeboard, ft	6	5	5	5
Reservoir				
Max. power pool elevation[a]	2,330	2,560	3,080	3,080
Min. power pool elevation[a]	2,325	2,550	3,018	3,018
Area at max. normal elevation, acres	121	476	40	183
Total storage capacity, acre-ft	6,400	34,711	1,350	10,200
Power storage capacity, acre-ft	585	4,536	1,250	7,640
Powerplant				
Number of units	1	1	1	
Installed capacity, kW	6,375	9,000	10,800	
Design head, ft	170	230	502	
Hydraulic capacity, cfs	520	600	261	
Average annual generation, MWh	23,200	31,600	41,600	

[a] *Based on USC and GS datum.*



GENERAL

EAST FORK PR

F E R C - Water Resources Appraisal For Hydroelectric Licensing

LOCATION MAP
SEVIER CO.
LOUDON CO.
BLOUNT CO.
HAYWOOD CO.
MONROE CO.
JACKSON CO.
CHEROKEE CO.
MACON CO.
CLAY CO.
GRAHAM CO.
SWAIN CO.
N
NC 281
69 - KV Transmission Line
WOLF CREEK RESERVOIR
Maximum Normal Elevation
3080 ft
Project Boundary
WOLF CREEK DAM
WOLF CREEK
EAST FORK RESERVOIR
Maximum Normal Elevation
3380 ft
Tunnel
Pipeline
TENNESSEE CREEK
POWERHOUSE
EAST FORK DAM
MAP
ROJECT

Figure 5

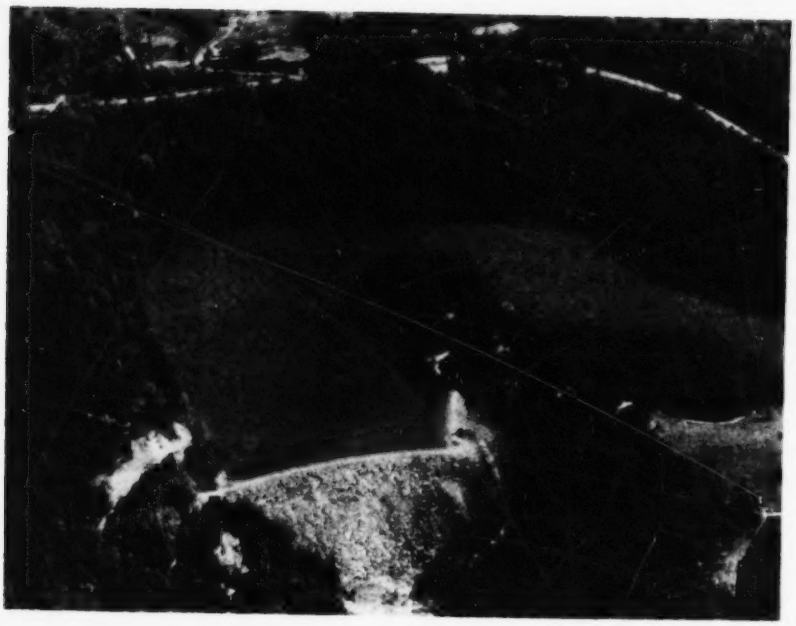


Figure 6. View of Cedar Cliff dam, and a portion of the reservoir

Figure 7. Bear Creek dam and reservoir

Figure 8. Wolf Creek dam and reservoir, viewed from upstream

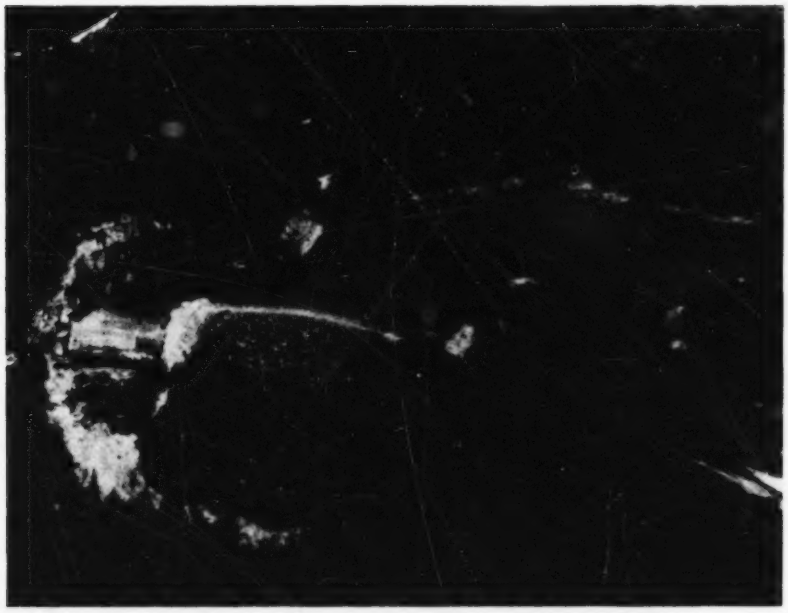


Figure 9. East Fork dam and reservoir

2,334 feet will provide 600 acre-feet of surcharge storage. The drainage area at the dam is 80.7 square miles with an average flow of 225 cubic feet per second. The intake to the water conduit, which is 128 feet below the normal water surface elevation of 2,330 feet, is located on the right side of and upstream from the dam. Water is conveyed from the reservoir through a pressure conduit of tunnel and steel pipe 1,138 feet long to the powerhouse located on the right bank of the East Fork at river mile 2.0 to develop the maximum gross head of 172.6 feet. The powerhouse contains a vertical shaft-type generator rated at 6,375 kilowatts.

Bear Creek

The Bear Creek development is the middle development of the East Fork project and includes a dam at river mile 4.8 (approximately 12.5 airline miles southeast of Sylva, North Carolina). The dam, which backs water up to the Tennessee Creek powerhouse, is 760 feet long and 215 feet high and of rockfill construction with a sloping earth core. The crest of the dam is at elevation 2,570 feet, which is 10 feet above normal full pool. The spillway, which was excavated in the rock abutment on the right side of the dam, has one 25-foot square float-controlled, electrically operated Tainter gate. In addition to the gated spillway, there are two small fuseplugs. One is 107 feet long with its crest at the breaching end at elevation 2,561 feet and its other end at elevation 2,563 feet. The other fuseplug is 276 feet long with its crest at the breaching end at elevation 2,562.5 feet and its other end at elevation 2,565 feet. The Bear Creek Dam impounds a reservoir which covers an area of 476 acres at maximum normal elevation 2,560 feet. The usable storage capacity is 4,536 acre-feet between elevations 2,560 feet and 2,550 feet; total storage capacity is 35,000 acre-feet. Design flood pool at elevation 2,565 feet will provide 2,400 acre-feet of surcharge storage. The drainage area at the dam is 75.3 square miles with an average flow of 213 cubic feet per second. The intake to the water conduit, 176.71 feet below the normal water surface elevation of 2,560 feet, is located on the right side of and upstream from the dam. Water is conveyed from the reservoir through a conduit 1,494 feet long to the powerhouse, which is located on the right bank of the river at river mile 4.5 to develop the maximum gross head of 230 feet. The powerhouse contains a vertical shaft-type generator rated at 9,000 kilowatts.

Tennessee Creek

The Tennessee Creek development is the uppermost development of the East Fork project. It consists of two sloping core earth- and rock-fill dams, East Fork and Wolf Creek. The East Fork Dam, which is 385 feet long and 140 feet high, is located on the East Fork of Tuckasegee River at river mile 10.9 (approximately 17 airline miles southeast of Sylva, North Carolina). There is a small embankment across a saddle in the left bank. This small saddle dam is also an earth- and rock-fill type, 255 feet long and 21 feet high. The top of the embankments is at elevation 3,090 feet, which is 10 feet above normal full pool. The spillway, which was excavated in the right abutment, has one 25-foot by 19-foot, float-controlled, electrically-operated Tainter gate. Also, there are two fuseplug dams. One fuseplug dam is 43 feet long with its crest at the breaching end at elevation 3,081 feet. The crest slopes upward to 3,081.5 feet at the other end. The other fuseplug is 97 feet long with its crest elevation at the breaching end at elevation 3,082 feet. The crest slopes upward to 3,082.5 feet at the other end. The East Fork Dam impounds a reservoir which covers an

area of 40 acres at maximum normal elevation 3,080 feet. The usable storage capacity is 1,250 acre-feet between elevations 3,080 feet and 3,018 feet, and total storage capacity is 1,350 acre-feet. Design flood pool at elevation 3,085 feet will provide 260 acre-feet of surcharge storage. The drainage area is 24.9 square miles with an average flow of 78 cubic feet per second. The intake to the water conduit is located on the right side of the reservoir upstream from the dam. A 12.5 foot by 14 foot horseshoe tunnel, 968 feet long, connects the intake structure with the Wolf Creek tunnel and the main penstock tunnel. The invert for the horseshoe-shape tunnel is at elevation 2,978 feet.

The Wolf Creek Dam, 810 feet long and 180 feet high, is located on Wolf Creek at river mile 1.7 (approximately 16.5 airline miles southeast of Sylva, North Carolina). The top of the dam is at elevation 3,090 feet, and its shape is similar to the East Fork Dam. The Wolf Creek spillway is similar to the East Fork spillway. It is in an excavated channel and is closed by a 25-foot by 19-foot, float-controlled, electrically-operated Tainter gate. There are also two fuseplug dams. One fuseplug dam is 36.4 feet long with its crest at the breaching end at elevation 3,082 feet. The crest slopes upward to 3,082.5 feet at the other end. The second fuseplug is 37.2 feet long, and the end crest elevations are 3 and 3.5 feet above the maximum normal reservoir elevation of 3,080 feet. The Wolf Creek Dam impounds a reservoir which covers an area of 183 acres at an elevation of 3,080 feet and has a usable storage capacity of 7,640 acre-feet between elevations 3,080 feet and 3,018 feet. The total storage capacity is 10,200 acre-feet. Design flood pool at elevation 3,085 feet will provide 900 acre-feet of surcharge storage. The drainage area is 15.2 square miles with an average flow of 47 cubic feet per second. The Wolf Creek intake structure is located on the left bank of the reservoir upstream from the dam. The Wolf Creek tunnel is 1,704 feet long. Both the East Fork and Wolf Creek tunnels connect to a main tunnel, 2,051 feet long, conveying water to the Tennessee Creek powerhouse. The powerhouse, located at the confluence of Wolf Creek and the East Fork of Tuckasegee River, is of reinforced concrete construction and houses a single vertical-shaft generator rated at 10,800 kilowatts.

The transmission system for the East Fork project consists of a 69-kilovolt, single-circuit, wood pole line beginning at the substation at Tennessee Creek powerhouse and continuing by way of the Bear Creek and Cedar Cliff powerhouses (where it is connected to project substations) to the switching station adjacent to Thorpe powerhouse, where the East Fork project line is connected to the Nantahala's transmission and distribution system at the point of attachment to the 69-kilovolt switching structure at Thorpe. The line is 8.5 miles long, about 1 mile of which is over the reservoir and streambed. No new transmission line construction is required for this project, and none is contemplated for the future.

Condition of the Project

The FERC Atlanta Regional Office made prelicense inspections of the entire project and reported that hydraulic structures, appurtenant facilities, powerhouses, and generating equipment for all three developments were found to be in good condition and well maintained. The staff has reviewed the designs for the Cedar Cliff, Bear Creek, East Fork, and Wolf Creek Dams and their appurtenant concrete structures and considers them to be in accordance with acceptable design practice. It is also concluded that they are safe and adequate for continued use. In addition, the staff has reviewed the significance of climate,

geology, basin topography, and all available data and flood records relevant to the East Fork of Tuckasegee River and adjacent river basins to determine the probability of peak floods of greater magnitudes at the four dam sites within this project. The capacities of all the spillway complexes are considered adequate.

Operation

The East Fork project has been in operation under the New Fontana Agreement with TVA for more than 25 years. This agreement permits the operation of the plants to be coordinated with the operations of TVA's large system, while at the same time providing Nantahala Power and Light Co. with a power supply in accordance with the Agreement. Minimum flow releases have not been made at the East Fork project. Under the agreement, water is impounded and released to generate power in accordance with the directions of TVA during peak-load periods. The East Fork project develops all the head available on the East Fork of Tuckasegee River within the project limits. The total usable storage capacity of approximately 14,000 acre-feet permits utilization of a high percentage of total inflow for generation of power at all developments in the project.

During the period January 1 through March 31, the Bear Creek reservoir is normally operated between elevations 2,556 feet and 2,560 feet (4-foot drawdown). During the period May 1 through November 30, the reservoir is normally operated between elevations 2,558.5 feet and 2,560 feet (1.5-foot drawdown). During April, the minimum reservoir elevation varies progressively from 2,556 feet to 2,558.5 feet, and during December, the minimum reservoir elevation varies progressively from 2,558.5 feet to 2,556 feet. During low-flow periods, the reservoir may be drawn down to elevation 2,550 feet (10-foot maximum drawdown).

The Wolf Creek and East Fork reservoirs of the Tennessee Creek development are connected by pressure tunnels which allow the two reservoirs to be operated as a single reservoir. During the period January 1 through March 31, the Tennessee Creek development reservoirs are normally operated between elevations 3,063 feet and 3,080 feet (17-foot drawdown). During the period May 1 through November 30, the reservoirs are normally operated between elevations 3,073 feet and 3,080 feet (7-foot drawdown). During April, the minimum reservoir elevation varies progressively from 3,063 feet to 3,073 feet; and during December, the minimum reservoir elevation varies progressively from 3,073 feet to 3,063 feet. During low-flow periods, the reservoir may be drawn down to elevation 3,018 feet (62-foot drawdown).

The Cedar Cliff development is operated as a run-of-river plant. The 5-foot reservoir drawdown between elevations 2,330 feet and 2,325 feet contains only 585 acre-feet of storage capacity, which is used for generating power as needed to best utilize the flow discharge from the upstream Bear Creek powerplant.

The average annual power generation of the project developments were as follows: (1) Tennessee Creek, 41,600 megawatt-hours (1955-72); (2) Bear Creek, 31,600 megawatt-hours (1954-1977); and (3) Cedar Creek, 23,200 megawatt-hours (1952-77). The generating units in the three powerhouses of this project are remotely controlled from the Thorpe plant where an hourly log of generation, flows, and other data are kept. A person visits the plants daily for routine maintenance and a check of operations.

Recreational and Environmental Aspects

The development of the East Fork project resulted in the creation of four reservoirs -- East Fork reservoir (40 acres), Wolf Creek reservoir (183 acres), Bear Creek reservoir (476 acres), and Cedar Cliff reservoir (121 acres). Recreational activities in the reservoirs include fishing, boating, waterskiing, picnicking, swimming, camping, and sunbathing. The construction of the East Fork project replaced approximately 16 miles of trout stream with a much larger lake fishery that includes trout. The loss of this trout habitat was partially offset by the coldwater releases of the East Fork and West Fork projects. These releases changed the Tuckasegee River downstream of the projects from a warmwater smallmouth bass fishery to one suitable for trout. Since 1967, this stretch of the Tuckasegee River has been designated as "Public Mountain Trout Waters." All of the reservoirs are developed for recreational use, with Bear Creek reservoir being the most popular because of its larger size.

Wolf Creek, East Fork, and Bear Creek reservoirs are stocked with rainbow and brown trout by the North Carolina Wildlife Resources Commission. The State also stocks Bear Creek and Cedar Cliff reservoirs with smallmouth bass. In addition to trout and smallmouth bass fishing, a warmwater fishery in the reservoirs also exist for largemouth bass, rock bass, white crappie, and sunfish. Wolf Creek and East Fork reservoirs are used primarily by bank fishermen, although some boat fishing does occur. Bear Creek and Cedar Cliff reservoirs are used mostly for boat fishing, pleasure boating, and waterskiing. The State, in cooperation with the applicant, operates boat launches on the reservoirs.

There is minimal use of the reservoir by waterfowl, and the project area supports limited hunting. However, a fair amount of hunting does occur in southwestern North Carolina for small game, and some regulated hunting for bear and deer occurs on government game protective areas. Game management is practiced on Forest Service lands.

Waters of the East Fork project have been classified as Class C (suitable for fishing and fish propagation, irrigation, industrial cooling, and other uses for water of low quality). Normally swimming and domestic water use require a higher classification, but swimming and other water contact sports occur in the reservoirs. There are no known major pollution sources in the reservoirs or in the streams feeding them. As boating, swimming, and camping increase, pollutants associated with these activities will be added to the waters of the reservoirs. Waters withdrawn from the reservoirs, especially Cedar Cliff (the most downstream development), have a low dissolved oxygen content at times. However, oxygen levels are normally restored within a short distance downstream and do not impose a serious threat to the Tuckasegee River biota.

Maintenance of minimum flow releases is the major environmental consideration in connection with the East Fork project, and is inseparable from the consideration of such releases of the West Fork project. The two forks meet to form the Tuckasegee River, 2.0 and 1.7 miles downstream from the Cedar Cliff and Tuckasegee Dams on the East and West Forks, respectively. Caney Fork Creek joins the Tuckasegee 3 miles below the confluence. From this point the remaining 17-mile segment of the river to the Dillsboro Dam is designated public mountain trout water. Two other tributaries join the river at about 7 and 13 miles below the confluence. Scott Creek joins the Tuckasegee River below Dillsboro Dam and had contained wastes from a paper pulp mill at the town of Sylva which had

imposed a pollution load equivalent to a population of 53,000. At present, there are no controlled minimum releases from either the East Fork or West Fork projects when the lowermost powerplants are not generating. However, seepage flows usually total more than 10 cubic feet per second in the two stream channels.

The North Carolina Wildlife Resources Commission has recommended that a minimum flow of 54 cubic feet per second, its estimate of the historical 7-day average minimum flow prior to impoundment, be provided at the confluence of the East and West Forks in the interest of water quality and fish habitat. The U.S. Department of the Interior has concurred, regarding the 17-mile segment of the Tuckasegee River designated public mountain trout stream. The Wildlife Resources Commission also has stated that a reasonable instantaneous minimum flow would be beneficial in controlling the fungus Sphaerotilus, which was nourished by dissolved carbohydrates included in the pulp mill waste on Scott Creek. During low-flow conditions this fungus can blanket the stream bottom and disrupt the natural processes necessary for maintenance of a favorable trout habitat.

Nantahala Power and Light Company and TVA believe, however, that the fish habitat has remained favorable with frequent flows of less than 15 cubic feet per second. Therefore, a 54 cubic feet per second minimum flow requirement is believed to be excessive. Nantahala has also suggested that the correct minimum flow figure prior to impoundment should have been 33 cubic feet per second, not 54; and the unregulated flow at the confluence would have averaged less than 50 cubic feet per second for two consecutive months after filling the impoundment in 1954. Additionally, TVA has stated that Caney Fork Creek seldom carries less than 35 cubic feet per second, and the two other creeks which enter the river farther downstream have similar contributions. Based on Nantahala's and TVA's flow estimates, significant benefits would be attained only in the 3-mile section of the Tuckasegee River upstream of Caney Fork Creek.

TVA has estimated that the change in operation required to maintain 54 cubic feet per second minimum flow would result in the loss of about 4,100 kilowatts of dependable generating capacity and the transfer of about 8,500,000 kilowatt-hours of energy from peak to offpeak periods.

It has recently been learned, however, that the pulp mill at Sylva, North Carolina--the only pulp mill in the Little Tennessee River basin--has been closed by the former owner, the Meade Corporation. Jackson Manufacturing Co. has bought the plant and plans to reopen it in about 2 years using a paper recycling process to make corrugated paper box material. This would not require great volumes of water. Jackson also plans to use water from Scott Creek but subsequently to pretreat the effluent which will be then treated by the Sylva, North Carolina sewage treatment facilities. The only other known plants in the area make textile products at three plants. Effluent is also treated at the Sylva, North Carolina facilities.

The North Carolina Wildlife Resources Commission contention also states that the 54 cubic feet per second should not include tributary inputs, e.g., from Caney Fork Creek and Cullowhee Creek, but should be in addition to these inputs. The State Commission's latest position is to continue to require the 54 cubic feet per second, until a habitat-discharge method can be utilized to determine minimum instream flows for the projects. The State Commission feels justified in requiring low flows, because the President's Water Policy Reform

Message (July 6, 1978) recommends that consideration be given to minimum flow requirements on all new reservoirs and that existing projects be investigated regarding benefits and practicality of modification for minimum flow releases. The State Commission also states that the Law of Riparian Rights gives a riparian proprietor the right to have preimpoundment stream-flow conditions, i.e., without a decrease in quantity or quality.

The North Carolina Wildlife Resources Commission is also requesting that the project reservoirs containing warmwater fisheries, maintain nearly constant reservoir levels during a 2-week period of the bass spawning season. This period would start when reservoir temperatures at the 5-foot depth contour reached 65 degrees Fahrenheit. Year-class strength for largemouth bass have been demonstrated to be determined during the first few weeks of life. To maintain acceptable year-class strength, reservoir levels should remain nearly constant during this period.

CHAPTER VI

THE WEST FORK PROJECT

The West Fork project, located on the West Fork of the Tuckasegee River with its tributaries in Jackson County, North Carolina, is operated by the Nantahala Power and Light Company. On August 30, 1968, the company filed an application for license on its existing West Fork project (FERC Project No. 2686) for the continued operation and maintenance of the hydroelectric generating stations. The project includes two developments, Thorpe and Tuckasegee, which were completed in 1941 and 1950, respectively, under authorization of the FPC, TVA, and the North Carolina Utilities Commission. Total installed nameplate capacity of the project is 24,600 kilowatts, and average annual generation is approximately 95,000 megawatt-hours. The plants were designed with high heads to develop capacity with a limited amount of water.

History

Construction of the Thorpe development (originally named Glenville Reservoir and renamed Thorpe in 1951) was started in September 1940. Closure of the dam was effected on February 12, 1941, and electrical energy was first generated on October 14, 1941. Construction of the Tuckasegee development was started in April 1949. Closure of the dam was effected on May 24, 1950, and electrical energy was first generated on May 26, 1950.

Nantahala filed with the FPC declarations of intention to construct for Thorpe and Tuckasegee developments on May 2, 1940, and November 18, 1948, respectively. The Commission found that the interests of interstate or foreign commerce would not be affected by the proposed construction, and no lands or reservations of the U.S. would be involved. Accordingly, construction of these developments without licenses, was authorized by section 23(b) of the Federal Power Act upon compliance with the State law. Nantahala contends that the project was lawfully constructed and operated pursuant to such authorization. By an order, pursuant to sections 4(g) and 309 of the Act, the Commission held that licenses were required by Nantahala and directed the filing of license applications for projects previously authorized under section 23(b) of the Act. The Commission's order was upheld by the reviewing courts. Therefore, Nantahala filed an application which FPC received on September 3, 1968, for a major license for the constructed West Fork project. The West Fork project is also operated under the New Fontana Agreement. This agreement between Nantahala and TVA provides for power from West Fork and other plants owned by Nantahala to be made available to TVA, which in turn provides power to Nantahala in accordance with the agreement. A water quality certificate for the West Fork project, dated October 27, 1972, was received from the North Carolina Board of Water and Air Resources.

The Thorpe development was financed by capital furnished by Nantahala's parent corporation. The Tuckasegee development was financed in part by capital

furnished by Nantahala's parent corporation and in part by cash from Nantahala's operations.

Description of Physical Works

The primary purpose of the West Fork project is to provide electric power to meet the rapidly growing demands of the area, which includes six southwestern North Carolina counties. Pertinent data for the West Fork project are given in tables 10 and 14. A general map of the project area is shown on figure 10. The general plans of Thorpe and Tuckasegee developments are shown as photographs on figures 11 and 12. The West Fork project basically involves the operation and maintenance of two dams and reservoirs totalling about 71,160 acre-feet of storage, two tunnels and penstocks, and two downstream powerhouses with associated transmission facilities.

Thorpe

The Thorpe development consists of an earth and rockfill dam 900 feet long with a maximum height of 150 feet and having a 12-foot-square bypass tunnel in the east abutment controlled by two motor-operated sluice gates in tandem with an earth and rockfill saddle dam 410 feet long having a maximum height of 122 feet, and a spillway having two 25-foot by 12-foot Tainter gates and six "fuse-plug" dams of compacted earth and sandy material; a reservoir at elevation 3,491.75 with a surface area of 1,462 acres having useful storage of 67,100 acre-feet at 76.75 feet maximum drawdown; a pressure conduit including three tunnels, two sections of steel pipe and steel penstock which bifurcates at the powerhouse; a powerhouse containing one generator rated at 21,600 kilowatts; and appurtenant facilities. A maximum head of 1,207.3 feet is developed at Thorpe powerhouse as the water travels through about 3 miles of penstock before discharging into the Tuckasegee reservoir. Tuckasegee reservoir is about 6 miles downstream from Thorpe Dam. The dam is located on the West Fork of the Tuckasegee River about 13 airline miles south of Sylva, North Carolina, and 13.5 airline miles east of Franklin, North Carolina. The powerhouse is located on the right bank of the West Fork of Tuckasegee River at river mile 3.4. The average annual flow at Thorpe Dam, which has a drainage area of 36.7 square miles, is 113 cubic feet per second. For a normal drawdown of 32 feet, Thorpe reservoir contains 40,000 acre-feet of storage capacity, creating a capacity for high utilization of runoff.

Tuckasegee

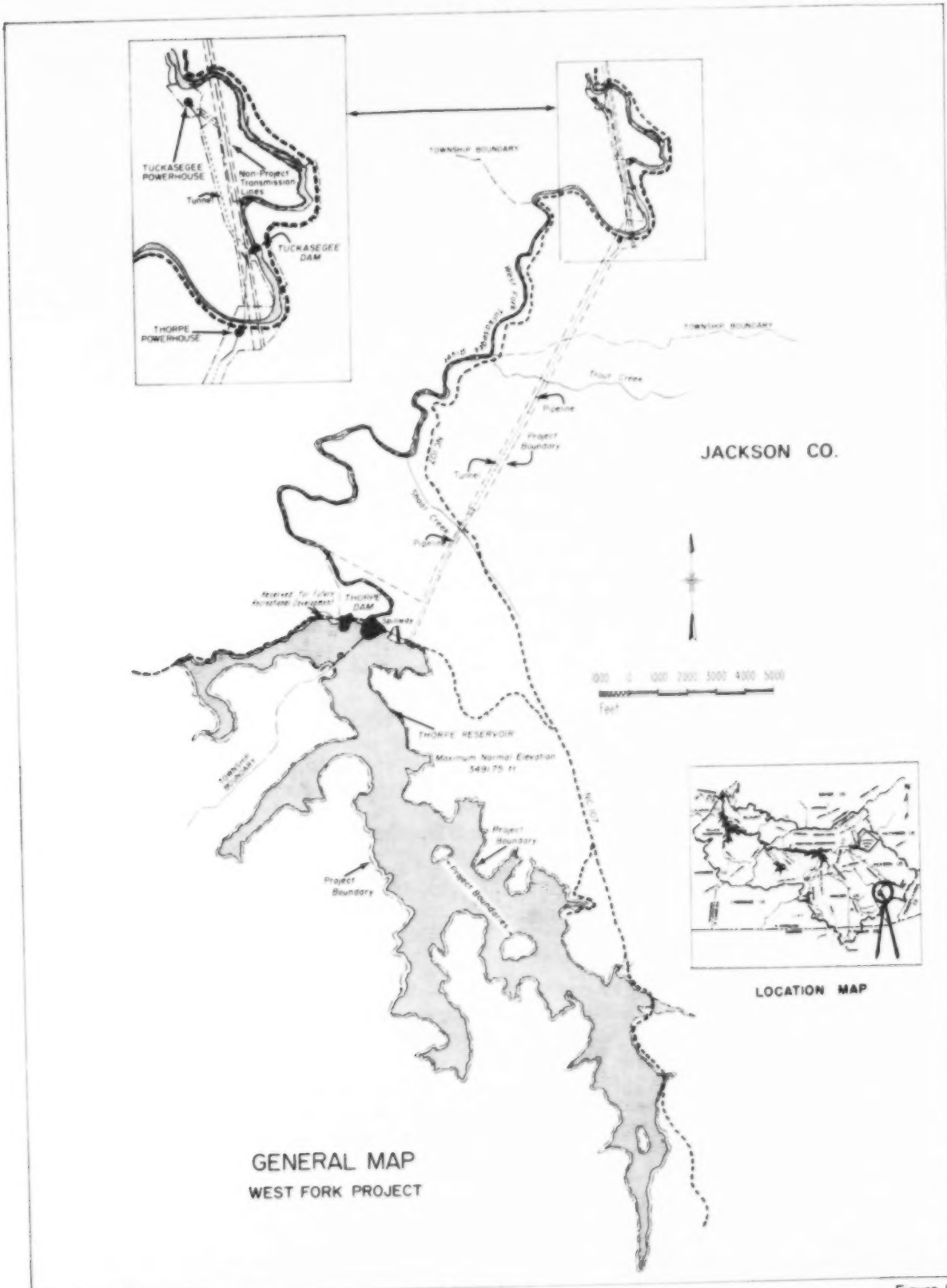
The Tuckasegee development consists of a thin concrete arch dam 254 feet long with a maximum height of 61 feet, and having a spillway forming the crest of the dam at elevation 2,275.75 feet topped by 3-foot-high flashboards; a reservoir with surface area of 7.9 acres at maximum normal elevation 2,278.75 feet (top of flashboards) with usable storage capacity of 35 acre-feet at 4-foot drawdown; a pressure tunnel 3,246 feet long partly lined and unlined leading to a surge tank 15 feet in diameter; a powerhouse containing one generator rated at 3,000 kilowatts; and appurtenant facilities. A maximum gross head of 120 feet is developed through 3,246 feet of tunnel and penstock which connect the dam and powerhouse. Turbine discharge flows in a tailrace canal 275 feet long to the river at mile 1.7. The Tuckasegee reservoir, with a drainage area of 54.7 square miles, has an average annual discharge of 151 cubic feet per second.

Table 14

Pertinent Data, West Fork Project
Little Tennessee River Basin

General		
Plant name	Thorpe	Tuckasegee
River	West Fork of Tuckasegee	West Fork of Tuckasegee
River mile	3.4	3.1
Drainage area, sq mi	36.7	54.7
Mean flow, cfs	113	151
Primary purpose	power production	power production
Dam		
Type	earth and rockfill	concrete arch
Max. height, ft	150	61
Length, ft	900	254
Spillway		
Design flood, cfs	49,500	45,000
Crest of spillway[a]	3,480	2,275.75
Reservoir		
Max. power pool elevation[a]	3,492	2,279
Min. power pool elevation[a]	3,415	2,275
Area at max. normal elevation, acres	1,462	7.9
Total storage capacity, acre-ft	71,800	168
Power storage capacity, acre-ft	67,100	35
Powerplant		
Number of units	1	1
Installed capacity, kW	21,600	3,000
Design head, ft	1,150	118
Hydraulic capacity, cfs	258	403
Average annual generation, MWh	83,300	11,300

[a] *Based on USC and GS datum.*



FERC - Water Resources Appraisal For Hydroelectric Licensing

Figure 10

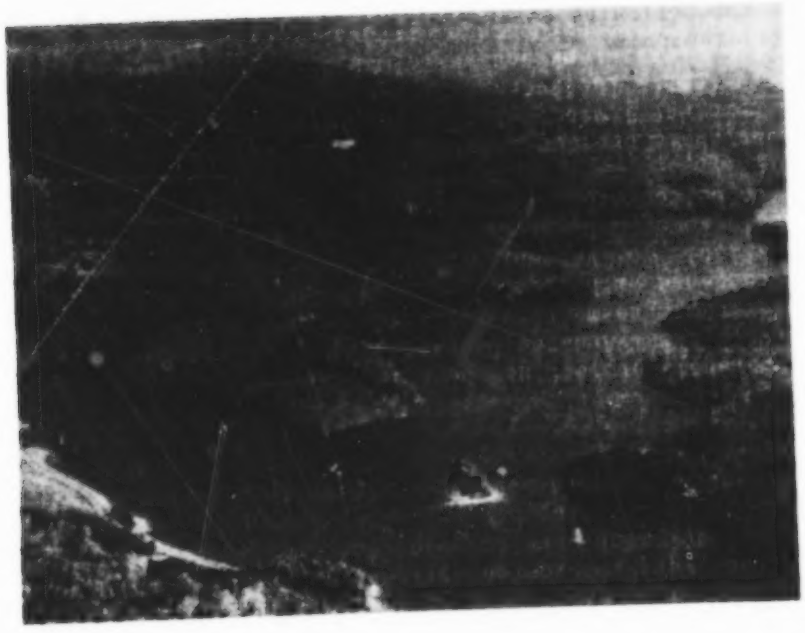


Figure 11. The central portion of Thorpe reservoir

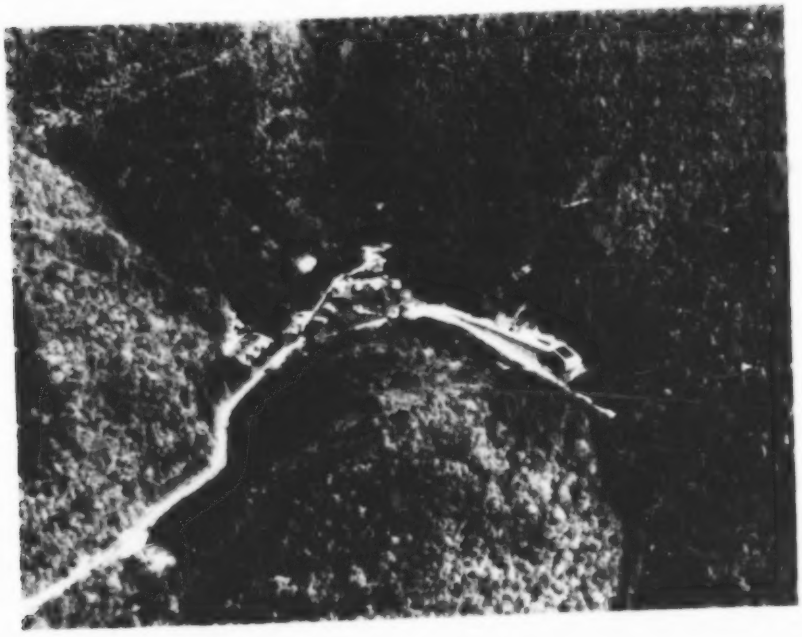


Figure 12. Thorpe powerhouse, and Tuckaseegee dam and reservoir

The Tuckasegee unit is remotely controlled from Thorpe powerhouse and is connected to the Thorpe generator bus by a 6.6-kilovolt transmission line. The Thorpe development is connected to Nantahala's transmission and distribution system at the following points in the substation located adjacent to the powerhouse: (1) the point of attachment of the 161-kilovolt station bus to the 161-kilovolt switching structure, and (2) the point of attachment of the 6.6-kilovolt Thorpe generator bus to a 6.6/12.5-kilovolt distribution substation. There are five transmission lines at the nearby switchyard, which are not considered to be a part of the project for licensing purposes. The highest voltage overhead line (161 kilovolts) connects Tápoco, Inc., in Graham County with Thorpe substation. This 161-kilovolt line is in turn connected to the TVA system. The other four overhead transmission lines at the plant operate at 66 kilovolts. One line ties the East Fork project with the Thorpe substation, another extends southward and terminates at the Shortoff substation north of Highlands, and the remaining two lines extend northward to connect with a substation near Dillsboro and a substation serving Western North Carolina University. The transmission facilities of the West Fork project listed below are subject to license: (1) the main generator leads to both the Thorpe and Tuckasegee plants; (2) appurtenant facilities necessary to connect the main generator leads to 6.6/161-kilovolt step-up transformer; (3) the 6.6-kilovolt transmission line approximately 1.8 miles long, connecting the Tuckasegee and Thorpe powerplants at the Thorpe generator bus; and (4) the three 6.6/161-kilovolt step-up transformers. No new transmission line construction is required for this project, and none is contemplated for the future.

Condition of the Project

The initial prelicense inspection of the Tuckasegee development was made by the FERC Atlanta Regional Office on April 10, 1969, with a report thereon dated June 4, 1969. Followup inspections were made on May 21, 1973, and on August 8, 1978, with reports on these inspections being dated June 19, 1973, and October 11, 1978, respectively. During all three prior inspections, the development was found to be in good condition and working order. A fourth prelicense inspection was made on May 7, 1979, with a report dated June 4, 1979. Generally, the dam, foundation, and abutments are in very good condition. Minor seepage was noted along both abutments and minor cracking was noted along the downstream face of the dam; however, these conditions are not considered serious. Nantahala has completed replacing boards in the walkway above the dam. With the exception of this work, there have been no major additions, maintenance, or modifications to the dam since the 1978 inspection. The powerhouse, appurtenances, and equipment are found to be in good condition and well maintained. Other than a 3- to 4-day outage in October 1978, for routine annual maintenance, there have been no major additions, retirements, improvements, maintenance, or other changes in the powerhouse structure, appurtenances, or equipment since the 1978 inspection. During the fourth inspection, Nantahala furnished copies of a safety inspection report for the Tuckasegee development prepared by Hensley-Schmidt, Inc., Consulting Engineers. This report was prepared at the request of Nantahala in compliance with North Carolina State law. Based on those four field inspections, and review of the Hensley-Schmidt, Inc. report, the Tuckasegee development is considered to be in very good condition with no conditions observed that would affect the safety or adequacy of the project. The Hensley-Schmidt, Inc. report made the following recommendations for the purpose of maintaining the safety and integrity of the structures: (1) the operation of the trash sluice, hand-operated flashboard, and head gate should be tested on an annual basis, and

their operation should be logged for future reference; and (2) the inspection of the dam by Nantahala personnel should be continued on an annual basis. Nantahala is presently complying with these recommendations.

The initial prelicense inspection of the Thorpe development was made on April 8 and 9, 1969, with a report thereon dated July 14, 1969. Follow-up inspections were made by FERC Atlanta Regional Office on May 21, 1973, and on August 9 and 11, 1978, with reports on these inspections dated June 19, 1973, and October 23, 1978, respectively. Those reports found the development to be in good condition and working order with no conditions existing which adversely affect the safety or permanence of the Thorpe project. There have been no additions, modifications, improvements, major maintenance, or other changes in the dam, saddle dam, spillway, powerhouse, appurtenances, or equipment since the 1973 inspection.

Operation

Thorpe and Tuckasegee plants have been operating successfully for about 38 and 29 years, respectively. They are operated under the New Fontana Agreement with TVA dated December 22, 1962. This agreement superseded in part an earlier agreement of August 14, 1941.

The West Fork project develops all available head on the West Fork of Tuckasegee River within the project limits. The large usable storage capacity of Thorpe (67,100 acre-feet) and the average flow of 113 cubic feet per second permits utilization of a high percentage of total inflow for generation of power at Thorpe and Tuckasegee developments.

The West Fork project in both its design and operation is subject to the control of TVA under provisions of section 26a of the TVA Act of 1933 as amended. The control of TVA under the act is exercised to achieve best utilization of available water resources.

The operating guide for Thorpe reservoir is given on figure 13. It includes a curve showing potential generation from usable storage through Thorpe and Tuckasegee plants and the operation pattern curve for Thorpe reservoir which was copied from the TVA "Operating Guide" for 1968. Approximately 67 percent of the drainage area of the Tuckasegee development is controlled by Thorpe reservoir. The upstream limit of Tuckasegee reservoir is near Thorpe tailrace and because of its small volume this reservoir is used only for daily and hourly pondage. Therefore, there are no operating rules for Tuckasegee reservoir.

The project is operated at the direction of TVA as part of the power supply for its large system and Nantahala's small system. Therefore, Nantahala could only speculate as to the load on the large TVA system at the time of critical flow in the small West Fork project, and for the purpose of this exhibit, dependable capacity has been determined by assuming that both reservoirs would be drawn to minimum normal operating elevations. Under these conditions, generating capability would be 21,600 kilowatts at Thorpe and 2,900 kilowatts at Tuckasegee.

During 36 calendar years, 1942 through 1977, actual power generation in Thorpe plant averaged about 83,300 megawatt-hours per year. During 1946 through 1950, water was spilled during periods of low power requirements equivalent to

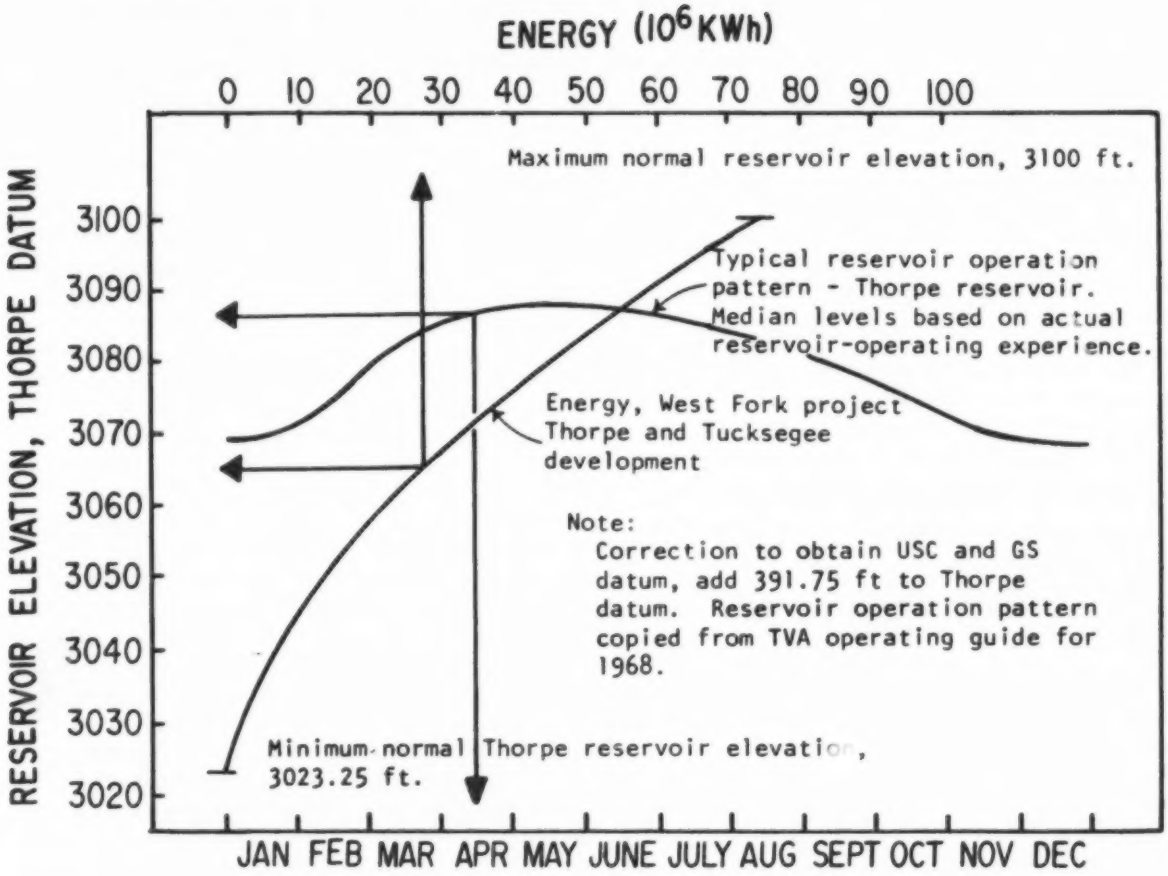

ENERGY (10⁶ KWh)
0 10 20 30 40 50 60 70 80 90 100
Maximum normal reservoir elevation, 3100 ft.
Typical reservoir operation pattern - Thorpe reservoir. Median levels based on actual reservoir-operating experience.
Energy, West Fork project Thorpe and Tucksegee development
Note:
Correction to obtain USC and GS datum, add 391.75 ft to Thorpe datum. Reservoir operation pattern copied from TVA operating guide for 1968.
Minimum normal Thorpe reservoir elevation, 3023.25 ft.
RESERVOIR ELEVATION, THORPE DATUM
3100
3090
3080
3070
3060
3050
3040
3030
3020
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC

Figure 13. Thorpe plant energy storage curve and operating guide.

1,000 megawatt-hours. If generation associated with this spillage were added to actual generation, average annual generation from stream flow for 1942 through 1977 would have been 84,300 megawatt-hours. The Tuckasegee development started generating in May 1950. During 27 calendar years of operation, 1951 through 1977, actual generation averaged 11,300 megawatt-hours.

Recreational and Environmental Aspects

Although the West Fork of the Tuckasegee River and its tributaries supported trout prior to the development of the West Fork project, recreational use of the area was minimal because of general inaccessability. Development of the project, with resultant creation of Thorpe reservoir (1,462 acres), Tuckasegee reservoir (7.9 acres), and improved road access, has increased fishing, boating, and other recreational opportunities in the area. Thorpe reservoir is used for boating, waterskiing, and fishing. Several islands on the reservoir are used for picnicking and primitive camping. The applicant has two licensed boat launching sites on the reservoir that require fees and has provided a free boat launch area. Undeveloped areas along the shoreline also provide access for boat launching. The applicant granted Jackson County rights to develop and operate two areas near the Thorpe Dam for picnicking, camping, fishing, boating, and other recreational activities. Due to the small size of the Tuckasegee reservoir, recreational use is limited mainly to bank fishing. Thorpe reservoir receives about 4,000 visitors per year while Tuckasegee reservoir has 200 t0 1,800 visitors annually. Much of the land in the area is national forest, and the U.S. Forest Service has developed several nearby camping and picnic areas.

The coldwater releases from the impoundments have changed the Tuckasegee River downstream of the project site into a good trout stream. The Tuckasegee reservoir and the river downstream of it are designated public mountain trout waters. Both reservoirs and the river downstream of them are stocked with trout by the State. In addition to rainbow trout, other game fishes in the reservoirs are: walleye, smallmouth and largemouth bass, white crappie, bluegill, pumpkinseed sunfish, and redbreast sunfish. Forage and rough fish species include gizzard shad, river chub, golden shiner, whitetail shiner, white sucker, northern hog sucker, and redhorse suckers. The game fish species are reported to be increasing in relation to other fish species. Anadromous fish species do not occur in the West Fork of the Tuckasegee River, so special fishway facilities are not necessary at either facility.

Oxygen-temperature profiles indicate that adequate water quality persists at all depths of the reservoir (Thorpe). However, the waters upstream and downstream of the project are classified Class C (suitable for fishing and fish propagation, irrigation, industrial cooling, and other processes needing lower water quality). Swimming and other water sports are prohibited. However, EPA records indicate that the water is of higher quality than is generally associated with Class C, and there are no known major sources of pollution upstream of the project.

The major environmental issue that has been raised in conjunction with both the West Fork and East Fork projects is a recommendation by the State of North Carolina for a requirement of a minimum low flow release of 54 cubic feet per second below the confluence of the West and East Forks of the Tuckasegee River. Refer to the Recreational and Environmental Aspects section of chapter V - The East Fork Project for a more detailed discussion of this issue. Chapter V also

discusses the request of the North Carolina Wildlife Resources Commission for hydroelectric projects to maintain a nearly constant reservoir level during bass spawning season.

The continued operation of the West Fork project will have no impact on land resources, including wildlife, because all of the developments have been in operation for several years. The continued operation of this project is not expected to change the quantity or quality of water from the conditions which have existed since completion of the developments. There is no pollution from the project and negligible pollution from the sparsely settled area near the project.

CHAPTER VII

THE NANTAHALA PROJECT

The Nantahala project is located in Macon and Clay Counties near the town of Franklin, North Carolina, on the Nantahala River, Dicks Creek, and White Oak Creek, all tributaries of the Little Tennessee River. The Nantahala Power and Light Company filed an application for a major license on November 1, 1968, to authorize the continued operation and maintenance of its constructed Nantahala project (FERC Project No. 2692) for generation of hydroelectric power. This project consists of the Nantahala development plus Dicks Creek and White Oak Creek diversion developments which were completed in 1942, 1948, and 1949, respectively, under authorization of the FPC, TVA, and the North Carolina Utilities Commission. Total installed nameplate capacity of the project is 43,200 kilowatts, and average annual generation is about 236,600 megawatt-hours.

History

Preliminary work in connection with the Nantahala development was started in March 1930 and was continued until July 1931, at which time the work was suspended because of adverse economic conditions. In July 1940, work was resumed, and closure of the dam was effected on January 30, 1942. Electrical energy was first generated on July 6, 1942. The Nantahala development was financed by capital furnished by Nantahala's parent corporation. Construction of Dicks Creek and White Oak developments were started in February 1948. The diversions of Dicks Creek and White Oak Creek into the Nantahala pipeline were effected on November 5, 1948, and on April 29, 1949, respectively. These diversion developments were financed in part by capital furnished by Nantahala's parent corporation and in part by cash from Nantahala's operations. Small diversion dams were built on Dicks Creek and White Oak Creek, which provided additional flow into the project.

Similar to the history of East and West Fork projects, Nantahala filed a declaration of intention with FPC prior to the construction of the Nantahala development and each of the two diversion developments. In each case, the Commission found that the developments would not affect interstate commerce and the project was authorized pursuant to section 23(b) of the Federal Power Act. The Nantahala project is also subject to the control of TVA under the provisions of section 26a of the TVA Act of 1933 as amended. This section requires TVA to exercise control to achieve the best utilization of available water resources. In addition to TVA's general authority over the developments of the streams, it has more direct control under an agreement with Nantahala dated December 22, 1962, known as the New Fontana Agreement, which superseded in part an earlier agreement of August 16, 1941. This agreement permits the operations of the plants to be coordinated with the operations of TVA's system.

Description of Physical Works

The Nantahala development includes a dam at river mile 22.8, which impounds the water in the Nantahala reservoir. Water is directed from the reservoir through a conduit consisting of tunnels and steel pipe to the powerhouse to develop the maximum gross head of 1,006 feet. The powerhouse is located near the left bank of the Nantahala River at river mile 13.6.

The Dicks Creek diversion development, which is located on Dicks Creeks, a tributary of the Nantahala River, includes a dam at creek mile 1.3 which impounds the water in a small reservoir. Adjacent to Dicks Creek Dam, there is Diamond Valley Dam, which diverts water from Diamond Valley Branch through a corrugated steel culvert pipe into Dicks Creek reservoir. Water is conveyed from Dicks Creek reservoir through a steel pipe into the Nantahala conduit.

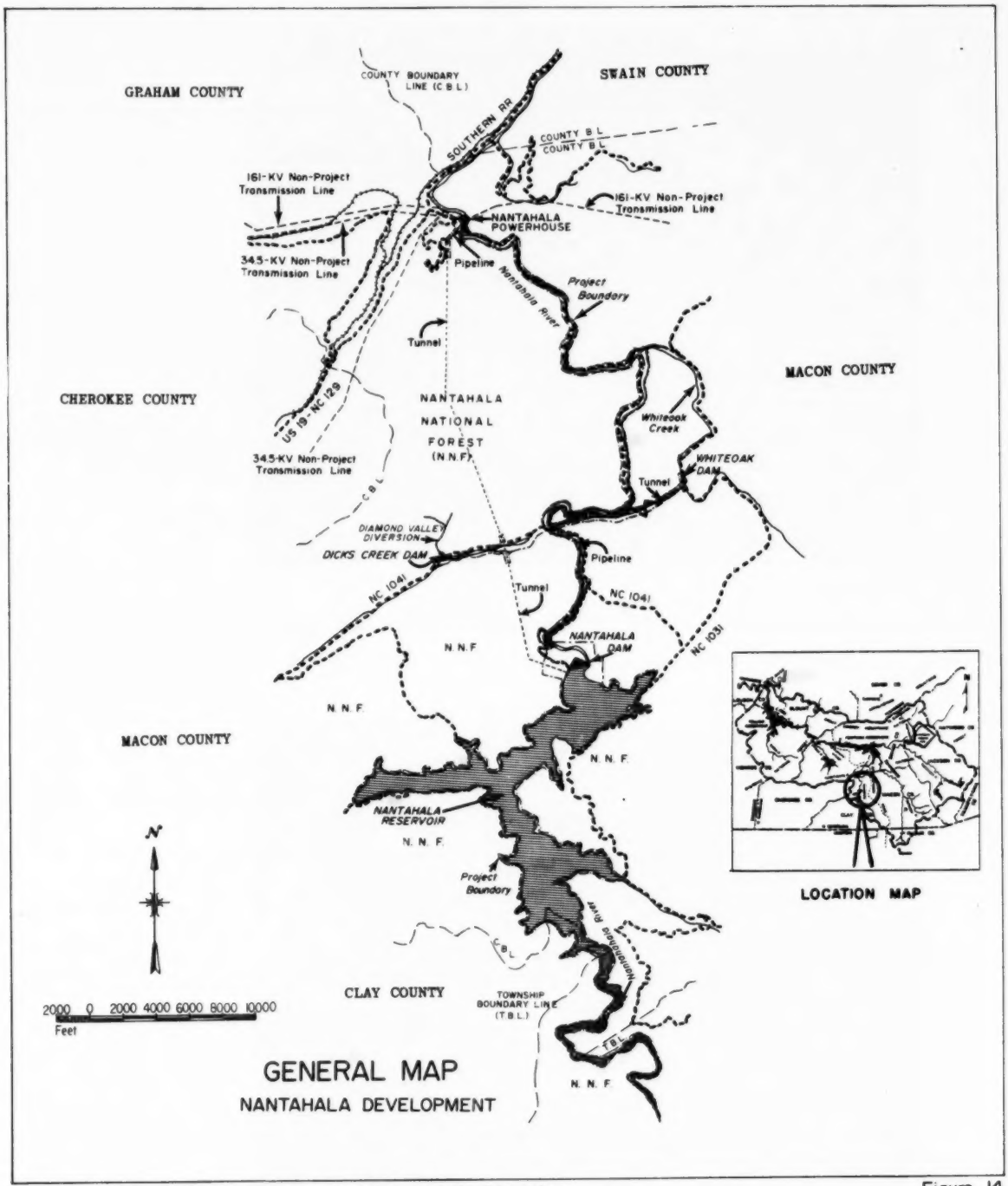
The White Oak Creek diversion development (which is located on White Oak Creek, a tributary of the Nantahala River) includes a dam at creek mile 2.3 that impounds water in a small reservoir. Water is conveyed from the reservoir through a conduit consisting of a section of tunnel, 7 feet by 7 feet, reducing to 52 inches in diameter, 2,045 feet long; and a section of steel pipe 52 inches in diameter, 9,400 feet long, into the Nantahala conduit.

Pertinent data for the Nantahala project are given in table 15. A general map of the area is shown on figure 14. Photos of the powerhouse and reservoir are presented as figures 15 and 16.

The Nantahala project works include an earth and rockfill dam 1,042 feet long with a maximum height of 250 feet, having a spillway excavated in rock at the east abutment of the dam with four Tainter gates and two "fuseplug" dams, a 16-foot diameter bypass tunnel in the west abutment controlled by two motor-operated sluice gates; a reservoir with an area of 1,605 acres at the maximum normal elevation of 3,012.16 feet having useful storage of 126,000 acre-feet at 131.2 feet maximum drawdown; a 5.6-mile-long pressure conduit leading from the dam to the powerhouse including tunnels, steel pipes and penstocks, and a surge tank; and a powerhouse with one generator rated at 43,200 kilowatts; Dicks Creek diversion consisting of a concrete-gravity dam 109 feet long and 16 feet high with a spillway forming the crest of the dam at elevation 3,027.16 feet surmounted by 3-foot-high flashboards, a small concrete-gravity dam (Diamond Valley) diverting water into Dicks Creek reservoir through a pipeline about 320 feet long, a steel conduit 24 inches in diameter and 3,870 feet long extending from Dicks Creek Dam to a junction with the Nantahala conduit; White Oak Creek diversion, which includes a concrete-gravity dam 115 feet long and 16 feet high with a spillway section forming the crest of the dam at elevation 3,025.16 feet surmounted by 7-foot-high flashboards, and a conduit about 2.2 miles long from the dam which discharges into the Nantahala conduit; a 161-kilovolt line interconnecting Nantahala powerhouse with Thorpe and Santeetlah powerhouses; and appurtenant facilities.

Condition of the Project

The initial prelicense inspection of the Nantahala project was made by the FERC Atlanta Regional Office on April 7 and 8, 1969, with a report dated June 6, 1969. Another inspection was made on May 23, 1973, with a report dated June 11, 1973. Both inspections found the project to be in good condition and working order. A third prelicense inspection was made on November 8, 1978. Based on



FERC - Water Resources Appraisal For Hydroelectric Licensing

Figure 14

Table 15

Pertinent Data, Nantahala Project
Little Tennessee River Basin

General	
Plant name	Nantahala
River	Nantahala
River Mile	13.6
Drainage area, sq mi[a]	108
Mean flow, cfs	318
Primary purpose	power production
Dam	
Type	earth and rockfill
Max. Height, ft	250
Length, ft	1,042
Spillway	
Design flood, cfs	54,800
Crest of spillway[b]	2,993
Reservoir	
Max. power pool elevation[b]	3,012.16
Min. power pool elevation[b]	2,880.96
Area at max. normal elevation[b]	1,605
Total storage capacity, ac-ft	138,730
Power storage capacity, ac-ft	126,000
Powerplant	
Number of units	1
Installed capacity, kW	43,200
Design head, ft	925
Hydraulic capacity, cfs	237
Average annual generation, MWh	236,600

[a] *Includes areas above diversions from Dicks and White Oak Creeks.*
[b] *Based on USC&GS datum.*

Figure 15. The mountainous setting of Nantahala dam and reservoir

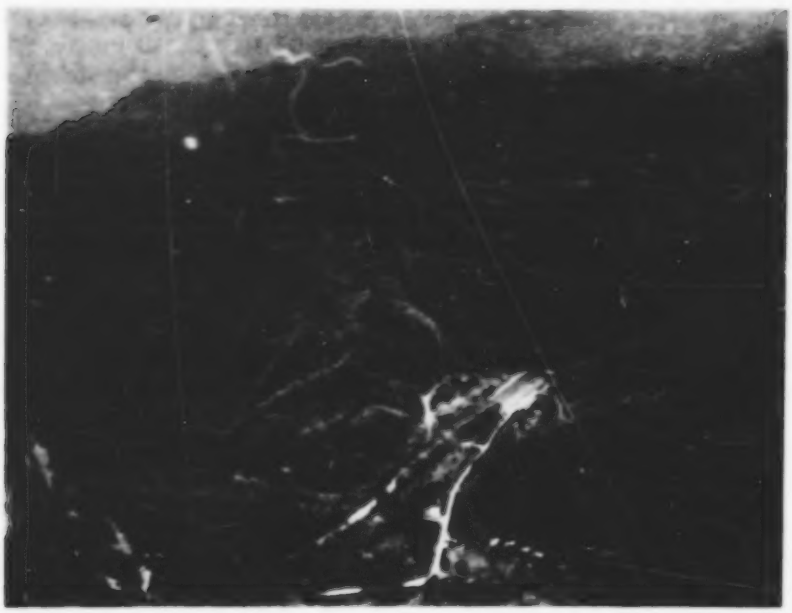


Figure 16. View of Nantahala powerhouse

this field inspection, the Nantahala project was considered to be in good condition and working order, with no conditions existing which would adversely affect the safety or adequacy of the project. During the inspection, it was recommended that the rocks which have fallen onto the Nantahala fuseplug be removed. Nantahala stated in a letter to Atlanta Regional Office dated January 5, 1979, that the rocks had been removed from the fuseplug and that both fuseplugs had been restored to their original design specifications. The Nantahala Dam and spillway have generally been well maintained. Field observations and settlement and deflection point readings indicate practically no additional embankment movement in recent years. The Dicks Creek and White Oak diversion dams appear to be in good condition. A small amount of seepage was noted at the Dicks Creek Dam and left abutment contact. Minor seepage was observed on both abutments, and a small amount of water was leaking between the flashboards in the White Oak Dam. All water conduits observed were in good condition. Several minor leaks were found, but none were considered serious enough for repairs. The powerhouse structure and equipment were in good condition and operating order. There were small cracks in the floors; however, they were present during the initial prelicense inspection and did not appear to be enlarging.

Operation

The Nantahala project has been in operation for about 27 years under an agreement with the TVA dated December 22, 1962, known as the New Fontana Agreement. Under the agreement, water is impounded and released and power is generated in accordance with directions from TVA. All power generated at the project is made available to TVA, which in turn makes power for system use available to the Nantahala Power & Light Company. This agreement permits the operation of the plant to be coordinated with the operations of TVA's system.

The Nantahala project develops all available head on the Nantahala River within the project limits. The large usable storage capacity of Nantahala is 126,000 acre-feet. The average flow available is 318 cubic feet per second, including the Dicks Creek and White Oak Creek diversion developments permiting utilization of a high percentage of total inflow for generation of power.

Similar to the East and West Fork projects, the Nantahala project in both its design and operation is subject to the control of TVA under provisions of section 26a of the TVA Act of 1933 as amended. The control by TVA under the act is exercised to achieve best utilization of available water resources.

The operating guide for Nantahala reservoir is shown on figure 17. It includes a curve showing potential generation from usable storage and the operation pattern curve which was copied from the TVA "Operating Guide" for 1968. As shown on the reservoir operating guide, the typical drawdown from May to the end of August, i.e. during the peak recreation season, averages about 23 feet and averages about 42 feet by mid-December. There is no usable storage capacity in the Dicks Creek and White Oak diversion reservoirs.

Nantahala development started generating in July 1942. Dicks Creek and White Oak diversion developments were placed in operation in November 1948 and April 1949, respectively. The average annual generation (1942-1977) was 230,315 megawatt-hours.

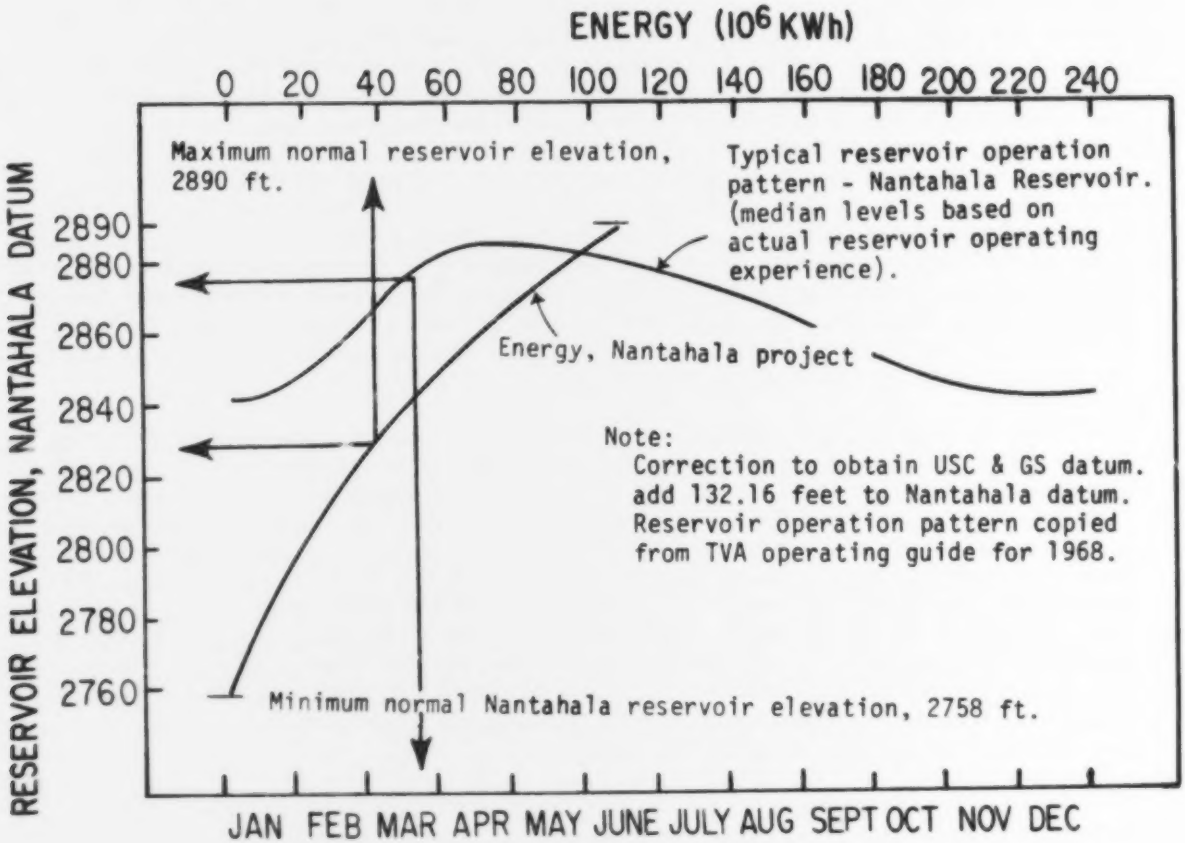

ENERGY (10⁶ KWh)
0 20 40 60 80 100 120 140 160 180 200 220 240
RESERVOIR ELEVATION, NANTAHALA DATUM
2890
2880
2860
2840
2820
2800
2780
2760
Maximum normal reservoir elevation, 2890 ft.
Typical reservoir operation pattern - Nantahala Reservoir. (median levels based on actual reservoir operating experience).
Energy, Nantahala project
Note:
Correction to obtain USC & GS datum. add 132.16 feet to Nantahala datum. Reservoir operation pattern copied from TVA operating guide for 1968.
Minimum normal Nantahala reservoir elevation, 2758 ft.
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC

Figure 17. Nantahala plant energy storage curve and operating guide.

Recreational and Environmental Aspects

Prior to development of the Nantahala project, recreational use (essentially fishing) was minimal in the area due to poor access. The development of the 1,605-acre Nantahala reservoir, with improved road service for public access, has greatly increased recreational use of the Nantahala River area. The project waters are open to the public for both fishing and hunting. Fishing is the primary recreational use of the reservoir, with pleasure boating and waterskiing also occurring. Swimming is limited due to the generally cold temperatures in the reservoir. The U.S. Forest Service provides boating, camping, picnicking, and other recreational facilities at or near the project. The State (North Carolina Wildlife Resources Commission), in cooperation with the applicant, maintains two boat launching sites on the reservoir. There are two privately developed boat rental operations also on the reservoir. Overall recreational development and use of the reservoir is limited due to the steepness of much of the shoreline, occurrence of reservoir drawdown during the recreational season, and the close proximity of three TVA reservoirs more acceptable for recreational use and located closer to surrounding towns. The Nantahala River below the project is used by canoeists, kayakers, and rafters.

Both warmwater and coldwater fishing is provided in the reservoir. Game fish include largemouth and smallmouth bass, bluegill, crappie, walleye, rainbow and brown trout, and kokanee salmon. The 27-mile reach of the Nantahala River from the Fontana reservoir to, and including, Nantahala reservoir are designated as trout waters by the North Carolina Wildlife Resources Commission. The Nantahala reservoir is the largest body of water in North Carolina so designated. Therefore, the State maintains the trout fishery by restocking. Anadromous fish runs do not occur in the Nantahala River so special fishway facilities are not needed at the project. Limited hunting occurs within the project vicinity, although hunting is allowed in southwestern North Carolina for small game and regulated hunting for bear and deer on government game protection areas. Little use of the reservoir is made by waterfowl.

To aid in maintaining water quality standards for the purpose of fish and wildlife conservation and for other beneficial public uses, e.g., dilution of possible pollution effluents, a minimal release of 38 cubic feet per second was recommended by the North Carolina Wildlife Resources Commission in the late 1960s (presently a low flow of 30 cubic feet per second is requested). However, discharges as low as 22 cubic feet per second have occurred and flows between the dam and powerhouse are even lower. The State Commission states that the 6-mile reach of the Nantahala River between Nantahala Dam and the mouth of White Oak Creek is severely impacted by stagnant conditions and high temperatures in summer because of low minimum flows. Apparently more fishermen use and enjoy the river upstream of the powerhouse, implying that uncontrolled low flows are adequate to support trout. State and Federal agencies commenting on the application for project licensing and the applicant's draft environmental impact statement state that the project has not significantly affected water quality or the fish and wildlife resources of the area. This opinion has caused some agencies to feel that low-flow requirements should not be made part of the current licensing stipulations, but if future downstream developments occur, review of minimum flows would be warranted at that time. However, the State Commission maintains its belief that a minimal low flow requirement is justifiable. This issue is discussed more fully in chapter V under the Recreational and Environmental Aspects section. The request for nearly constant reservoir levels during bass

spawning season for reservoirs containing a warmwater fishery, e.g., Nantahala reservoir, is also discussed in that section.

CHAPTER VIII

FUTURE DEVELOPMENT OF WATER AND RELATED RESOURCES

Potential Basin Developments

Basin development is undertaken by the Tennessee Valley Authority, an agency set up by the TVA Act of May 18, 1933. The Act authorizes construction of water control projects for navigation, flood control, and production of electricity. It also provides for reforestation, marginal land use programs, agricultural and industrial development, certain national defense functions, and other purposes.

A large portion of the Little Tennessee River basin has been developed by Federal and non-Federal interests. The reaches of the Little Tennessee River that have not been fully developed include the headwaters and its tributaries in Swain, Jackson, Macon, and Graham Counties, North Carolina. The various potential hydroelectric developments that have been identified are listed in table 16. In studying potential pumped storage sites, it was considered that reservoirs would require sufficient storage capacities to assure at least 8 hours of continuous operation at full load during the generating cycle. The potential basin developments described below would have a total generating capacity of approximately 4,600 megawatts (98% pumped storage).

The Jackson County pumped storage project would consist of an upper reservoir on Frady Creek and a lower reservoir on Caney Fork. The powerplant would have a generating capacity of 1,000 megawatts using four generators of 250 megawatts each with an available gross head of approximately 1,398 feet. The upper reservoir would have a 420-foot-high rockfill dam, and the lower reservoir would include a dam about 225 feet high. A preliminary permit application for this project designated FPC Project No. 2732 was filed on June 6, 1973, but the application was withdrawn on June 5, 1975.

The Sols Creek pumped storage project investigated by FERC staff in 1971 would consist of an upper reservoir on Sols Creek and a lower reservoir on Bear Creek. The upper reservoir would have a 340-foot-high earth and rockfill dam with a gross storage capacity of 16,500 acre-feet and a power storage capacity of 13,500 acre-feet. The lower reservoir would make use of a 215-foot-high earth and rockfill dam to provide 37,400 acre-feet of storage capacity, with 13,400 acre-feet of this usable for power. The Sols Creek development would have a generating capacity of 500 megawatts based on a hydraulic capacity of 10,100 cubic feet per second, a gross static head of 760 feet, and a design head of 710 feet. The average annual generation would be about 438,000 megawatt-hours. The benefit-cost ratio for this development was estimated by FERC staff to be 1.32.

Table 16

Potential Hydroelectric Developments
Little Tennessee River Basin

Project	Type[a]	Stream	County	State	Drainage Area	Potential Capacity	Average Annual Energy
					(sq mi)	(kW)	(MWh)
Jackson County	P	Caney Fork	Jackson	NC	NA	1,000,000	NA
Sols Creek	P	Sols Creek	Jackson	NC	143	500,000	438,000
Needmore	P	Little Tenn. R.	Swain	NC	NA	5,000	25,000
Cullasaja	P	Ellijay Creek	Macon	NC	206	1,000,000	876,000
Smiths Bridge	P	Coweeta Creek	Macon	NC	17	1,000,000	876,000
Kelly Creek	P	Kelly Creek	Rabun	GA	113	1,000,000	876,000
Needmore	H	Little Tenn. R.	Swain	NC	439	32,830	115,300
Oconaluftee Lake	H	Tuckasegee R.	Swain	NC	603	44,800	157,400
Wesser	H	Nantahala R.	Macon	NC	133	21,770	61,600

[a] *H = conventional hydro.*
P = pumped storage.

The Needmore pumped storage project investigated by Nantahala Power and Light Company would be located on the Little Tennessee River in Swain County, North Carolina. The powerplant would have a gross static head of 150 feet. The installed generating capacity and average annual generation would be about 5,000 kilowatts and 25,000 megawatt-hours, respectively.

The Cullasaja pumped storage project would consist of an upper reservoir on the Ledford Branch and a lower reservoir on the Ellijay Creek. The upper reservoir would have a 410-foot-high earth and rockfill dam with a gross storage capacity of 37,000 acre-feet and a power storage capacity of 16,000 acre-feet. The lower reservoir would make use of a 150-foot-high earth and rockfill dam to provide 33,000 acre-feet of storage capacity, with 16,000 acre-feet of usable capacity for power generation. The Cullasaja development would have a generating capacity of 1,000 megawatts based on hydraulic capacity of 12,700 cubic feet per

second, a gross static head of 1,160 feet, and a design head of 1,125 feet. The average annual generation would be about 876,000 megawatt-hours. This development was studied by FERC staff, and the benefit-cost ratio was estimated to be about 1.14 in 1974.

The Smiths Bridge pumped storage project would consist of an upper reservoir on Dryman Fork and a lower reservoir on Coweeta Creek. The upper reservoir would have a 455-foot-high earth and rockfill dam with a gross storage capacity of 42,000 acre-feet and a power storage capacity of 18,000 acre-feet. The lower reservoir would make use of a 130-foot-high earth and rockfill dam to provide 35,000 acre-feet of storage capacity, with 18,000 acre-feet of this usable for power generation. The Smiths Bridge development would have a generating capacity of 1,000 megawatts based on a hydraulic capacity of 15,700 cubic feet per second, a gross static head of 945 feet, and a design head of 912 feet. The average annual generation would be about 876,000 megawatt-hours. This development was investigated by FERC staff, and the benefit-cost ratio was estimated to be about 1.18.

The Kelly Creek pumped storage project would consist of an upper reservoir on Mud Creek and a lower reservoir on Kelly Creek. The upper reservoir would have a 250-foot-high earth and rockfill dam with a gross storage capacity of 36,000 acre-feet and a power storage capacity of 20,000 acre-feet. The lower reservoir would make use of a 160-foot-high earth and rockfill dam to provide 34,000 acre-feet of storage capacity, with 20,000 acre-feet of this usable for power generation. The Kelly Creek development would have a generating capacity of 1,000 megawatts based on a hydraulic capacity of 14,900 cubic feet per second, a gross static head of 1,023 feet, and a design head of 961 feet. The average annual generation would be about 876,000 megawatt-hours. This development was investigated by FERC staff, and the benefit-cost ratio was estimated to be 1.24.

As part of its National Hydroelectric Power Resources Study, the Corps of Engineers has recently published its Preliminary Inventory of Hydropower Resources (1979). Volume 5 of the series contained identification of the following three sites in the Little Tennessee River basin that were previously investigated by TVA, where conventional hydropower developments could be constructed.

The Needmore conventional hydro site would be located on the Little Tennessee River and would basically consist of a dam 187 feet high having a power head of 155 feet, and a reservoir storage capacity of 140,000 acre-feet. The powerplant would have a capacity of 32,830 kilowatts and would generate 115,300 megawatt-hours annually.

The Oconaluftee Lake development on the Tuckasegee River would consist of a dam 205 feet high with a power head of 155 feet, and a reservoir with storage capacity of 530,000 acre-feet. Generating capacity would be 44,800 kilowatts, with an average annual energy production of 157,400 megawatt-hours.

The Wesser development would be located on the Nantahala River and would include a dam approximately 300 feet in height and generating facilities having a capacity of 21,770 kilowatts and annual generation of 61,600 megawatt-hours.

While the indicated potential projects have been investigated to some extent by public or private interests, the economic, technical, and environmental feasibility of the developments is essentially unknown. A more detailed

feasibility study of the potential developments is beyond the scope of this report. No plans for construction of new hydroelectric facilities within the basin are known at this time.

Twenty-year peak power demand projections for the Tennessee Valley Subregion of the Southeastern Electric Reliability Council (as summarized by the National Electric Reliability Council in 1979) indicate peak power demand will more than double by the year 1998. However, projected electric energy resources (existing and planned new generation, and power transfers) for the Tennessee Valley Subregion are expected to meet the projected demand. Therefore, additional hydroelectric development within the Little Tennessee River basin may not occur before the year 2000.

Future Operation of Study Projects

Future use of the East Fork, West Fork, and Nantahala projects consist of their continued operation and the installation of additional generating capacity, if determined to be feasible. Applications for license for these projects, filed by Nantahala Power and Light Company, are pending.

Continued Operation of the Present Projects

The East Fork, West Fork, and Nantahala projects appear to be well-maintained, based on inspections performed annually by the Commission staff and also based on periodic inspections performed by an independent engineering consulting firm. Repairs and replacements have been made as needed, and the projects are physically capable of continued efficient operation for many years. The projects are a basic element of the comprehensive development of the Little Tennessee River basin.

The staff economic analysis, summarized in tables 17-19, used original project costs, generalized annual costs, actual 1977 production expenses, and generalized capacity and energy values for alternative steam-electric replacements for comparative purposes. The analysis basically was a comparison of the existing hydro plants with alternative steam-electric replacements of comparable capacity. As shown in tables 17 through 19, continued operation of the present facilities for an extended period was determined to be economically justified with annual benefits exceeding annual costs by ratios of 3.1 to 5.1. These projects have been in operation for many years and are a beneficial resource development of the area. The environmental effect of the existing projects also appears to be good in terms of fishing and wildlife resources, plant life, scenic values, water quality, and other environmental considerations. Licensing the projects should enhance the beneficial uses of the projects, and the primary use of the projects for generating power should continue for many years.

Abandonment

One alternative to the continued operation of the three hydroelectric projects would be their retirement. If all project works except the dams were abandoned, reserving the reservoirs for public recreational uses, a responsible agency would have to be appointed to maintain the safety of the structures. Also, the power generating capacities would be lost, which would cause a curtailment of power delivery to customers or would require replacement of capacity from another source. This alternative would necessitate probable replacement by

Table 17

Economic Analysis for the East Fork Project
Little Tennessee River Basin

COSTS	
Original Project Investment	$7,980,898
Generalized Annual Costs	
Fixed Charges	
Interest	10.5%
Depreciation	0.55%
Interim replacements	0.35%
Insurance	0.25%
Taxes (Federal, State, local)	3.66%
Total Percentage Charges	15.31%
Total Generalized Annual Costs	$1,221,876
Production Expenses (1977)	$117,581
Total Annual Costs	$1,339,456

BENEFITS

Annual Benefits	Replacement Alternatives	
	Coal	Nuclear
Capacity value[a] (dependable capacity - 20.7 MW)	$2,794,500	$3,974,400
Energy value[b] (avg. ann. generation - 93,500 MWh)	$1,309,000	$561,000
Total Annual Benefits	$4,103,500	$4,535,400
Benefit-to-Cost Ratio	3.1	3.4

[a] *At $135/kW coal-fueled and $192/kW nuclear-fueled.*
[b] *At 14 mills/kWh coal-fueled and 6 mills/kWh nuclear-fueled.*

Table 18

Economic Analysis for the West Fork Project
Little Tennessee River Basin

COSTS	
Original Project Investment	$7,355,088
Generalized Annual Costs	
Fixed Charges	
Interest	10.5%
Depreciation	0.55%
Interim replacements	0.35%
Insurance	0.25%
Taxes (Federal, State, local)	3.66%
Total Percentage Charges	15.31%
Total Generalized Annual Costs	$1,126,064
Production Expenses (1977)	$204,036
Total Annual Costs	$1,330,100

BENEFITS

Annual Benefits	Replacement Alternatives	
	Coal	Nuclear
Capacity value[a] (dependable capacity - 24.5 MW)	$3,307,500	$4,704,000
Energy value[b] (avg. ann. generation - 95,000 MWh)	$1,330,000	$570,000
Total Annual Benefits	$4,637,500	$5,274,000
Benefit-to-Cost Ratio	3.5	4.0

[a] *At $135/kW coal-fueled and $192/kW nuclear-fueled.*

[b] *At 14 mills/kWh coal-fueled and 6 mills/kWh nuclear-fueled.*

Table 19

Economic Analysis for the Nantahala Project
Little Tennessee River Basin

COSTS	
Original Project Investment	$9,958,537
Generalized Annual Costs	
Fixed Charges	
Interest	10.5%
Depreciation	0.55%
Interim replacements	0.35%
Insurance	0.25%
Taxes (Federal, State, local)	3.66%
Total Percentage Charges	15.31%
Total Generalized Annual Costs	$1,524,652
Production Expenses (1977)	$263,440
Total Annual Costs	$1,788,092

BENEFITS

Annual Benefits	Replacement Alternatives	
	Coal	Nuclear
Capacity value[a] (dependable capacity - 37 MW)	$4,995,000	$7,622,000
Energy value[b] (avg. ann. generation - 236,600 MWh)	$3,304,000	$1,416,000
Total Annual Benefits	$8,299,000	$9,038,000
Benefit-to-Cost Ratio	4.6	5.1

[a] *At $135/kW coal-fueled and $206/kW nuclear-fueled.*

[b] *At 14 mills/kWh coal-fueled and 6 mills/kWh nuclear-fueled.*

best copy available

best copy available

other types of generation such as fossil- or nuclear-fueled generating plants, which in themselves could have an adverse environmental impact and which use non-renewable natural fuel resources. Power could also be derived from construction of new hydroelectric projects, but considerable environmental impact from project construction would likely ensue.

Removal of all project facilities and structures would create significant impacts on the environment and recreation program. These effects are discussed in detail in a succeeding section of chapter VIII entitled Environmental Considerations.

Complete removal of the structures would cause a great economic loss to owners of shoreline homes and cottages. In addition to rendering useless the recreational development and future plans for development, it would deter the tourist trade, causing losses to the local economy, and flood control benefits would be lost. Property taxes paid by the Nantahala Power and Light Company to Jackson County in 1972 totaled $102,706, including $50,880 on West Fork properties. These taxes, comprising 6.6 percent of the total county levy, contribute significantly to the economy of the area.

Installation of Additional Generating Capacity

The installation of additional hydroelectric capacity at the projects may be possible by increasing the conventional capacity of the existing installations; or using the existing reservoirs as the pumping pools for pumped storage projects. This, however, must be done within the context of an amended agreement with TVA. No additional installations have been proposed for the East Fork, West Fork, and Nantahala projects. However, as increased capacity is required by the Nantahala Power and Light Company, further studies of additional installations may be warranted.

These three projects are now in existence and operating, and no modification of their operation or expansion of their plants or new construction is contemplated. There are no known plans for future development of the projects for hydroelectric production. Neither the Nantahala Power and Light Company, which owns the projects, nor the Tennessee Valley Authority, which requires preconstruction approval by its Board of Directors, has any plans or studies under way that would alter the present status of the projects. However, the East Fork project reservoirs offer an excellent opportunity for potential pumped storage development. The reservoirs could be used as afterbays for pumped storage projects which have forebays constructed in the mountains along the shorelines. One site on the right bank of Bear Creek reservoir has been studied by the FERC Atlanta Regional Office. About 500,000 kilowatts of capacity could be installed at that site. The possible installation of reversible pump-turbine generators at the East Fork project would increase the total capacity to about 530 megawatts. This redevelopment of the project, which is described in the potential Sols Creek pumped storage project under the heading of Potential Basin Developments in this chapter, would require the construction of a new dam to form a reservoir capable of acting as an upper power pool. Based on calculations by FERC in 1970, the annual incremental benefits from this development were determined, however, to be greater than the annual costs by a ratio of only 1.32/1.0. Alternative sites for power production are available in the vicinity of the East Fork project. There are several large capacity potential pumped storage hydroelectric development sites that could be developed in the area; however, compared

to the existing East Fork project these are not warranted as alternatives at this time because of low near-term need-for-power projections, high cost, and adverse environmental impacts that would result from new construction. The existing East Fork project is operating economically and under stable environmental conditions.

Environmental Considerations

No additional significant environmental effects will occur from the licensing and continuing operation of the East Fork, West Fork, and Nantahala projects. Unavoidable environmental effects associated with the operation of the projects will continue to occur. These include periodic low dissolved oxygen levels in short river sections downstream of the projects, fluctuating flows downstream of the powerhouses, lake habitat versus former stream habitats, and the presence of coldwater-regulated, open-flow streams below the projects rather than free-flowing (often warmwater) streams that existed prior to project development. These effects have not impaired use of project waters and have generally been beneficial. Continuing and increased recreational use of the reservoirs may cause some minor water quality degradation by contamination with pollutants associated with these uses, e.g., motorboat pollutants and sanitary waste effluents, but these effects should not significantly affect future recreational use.

Maintenance of minimum low flows below project dams could sustain or marginally improve both the fish habitat and quality and quantity of the fisheries below the projects. Maintenance of guaranteed low flows would decrease the chance of temporary dessication of portions of the streams that could stress or exterminate fish or fish food organisms. Additionally, maintenance of low flows could help relieve periods of downstream stagnation that occur during unregulated summer low flows. Requirements for low flows would also help to ameliorate inputs from pollution sources occurring downstream of the projects. The North Carolina Wildlife Resources Commission believes that the maintenance of low flows is justifiable, as discussed in detail in the Recreational and Environmental Aspects section of chapter V, but the applicant and TVA believe minimum flow requirements are not necessary and further contend that they would result in a loss of power generation.

Consideration in licensing should also be given to requiring minimal water level fluctuations within those reservoirs that contain a warmwater fishery; these include all project reservoirs except Tuckaseegee (Little Glenville). This regulation would be for a 2-week period, beginning when water temperatures at the 5-foot depth contour reach 65 degrees Fahrenheit. Since it has been demonstrated that largemouth bass year-class strength is determined within the first few weeks of life, such action during the bass spawning period would maintain acceptable year-class strength. TVA has agreed with the North Carolina Wildlife Resources Commission to minimize water level fluctuations within their reservoirs, and the State Commission has requested that Nantahala Power and Light also attempt to stabilize their reservoir water levels during this 2-week period.

The possible use of the East Fork project for future pumped storage would affect flow patterns and reservoir levels. Increases in turbidity levels would also result from such action. Impacts to stream and reservoir ecosystems during construction could be temporarily severe.

Abandonment of hydroelectric power generation, without removal of project structures, would alter the operating lake levels to some degree, but would not significantly change the environmental and recreational aspects of the projects. Complete abandonment, with removal of the project structures, would create serious adverse environmental (and economic) effects. Expensive removal and disposal of the accumulated silt in the reservoirs would be required and large quantities of silt would be washed downstream, causing detrimental impacts to the stream biota from the additions of suspended and settled solids for some period of time. Eventually fishing in the stream reaches downstream of the projects may become better from the more constant daily flows, although, according to discharge records, natural dry-season low flows could periodically be more severe than regulated low flows. The reservoirs would be eliminated, with the streams returning to the channel morphologies that existed prior to development of the projects. Large areas of unsightly, silt-laden shoreline would be exposed that would require expensive reclamation, e.g., silt disposal and revegetation. After habitat rehabilitation, wildlife areas that were eliminated by the development of the projects would be reinstated. The warmwater (and cold-water, where applicable) lake-like fishery would be replaced by a free-flowing, probably warmwater, fishery. Recreational use of the project areas would be greatly diminished. The reservoirs receive at least five times the recreational use per river mile than do unimpounded reaches. The variety of recreational opportunities that were afforded by the reservoirs would become limited to those that could be accommodated by free-flowing streams, e.g., fishing, rafting, and canoeing. Modifications of the reservoirs to free-flowing streams would also eliminate the flood protection qualities inherent in them.

CONCLUSIONS

The three projects under major license consideration (the East Fork, West Fork, and Nantahala projects) are in good physical condition and appear capable of providing an economic source of power for the foreseeable future.

An economic analysis, based on net depreciated investment, indicates that continued operation of the three projects is justified with benefits exceeding costs by ratios of 3.1 to 5.1.

Since all three hydroelectric projects are economically justified and are not environmentally harmful, abandonment of the projects would serve no useful purpose. Complete removal of dams at any of the projects would create significant, adverse economic and environmental impacts to reservoir recreation areas and downstream river reaches.

Potential basin hydroelectric developments identified to date would have an incremental total generating capacity of approximately 4,600 megawatts (98% from pumped storage), but the economic, environmental, and technical feasibility of the potential developments is unknown.

Increasing the generating capacity of all three projects detailed in this report is technically possible but should be assessed in more detail regarding economic and environmental considerations, particularly the East Fork project where there is significant pumped storage potential.

Minimum flow requirements recommended for the three projects by the State of North Carolina for environmental protection may not be environmentally justified at this time, particularly because of the potential loss in generating capacity.

Minimum water level fluctuations recommended for some project reservoirs by the State of North Carolina for protection of largemouth bass populations during the 2-week spawning period may be required.

*U S GOVERNMENT PRINTING OFFICE: 1981 338-472/8082